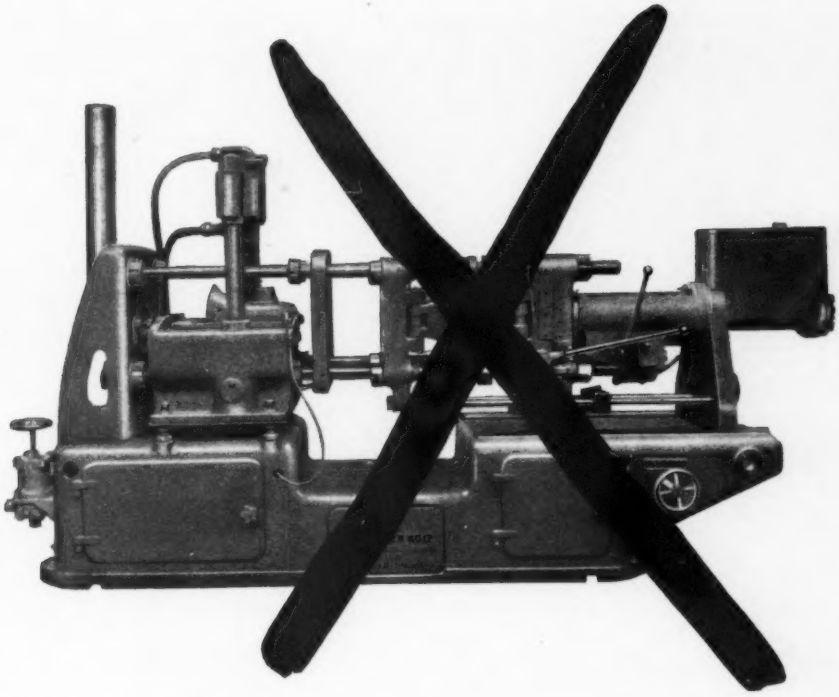
17 NOVEMBER 1961

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS

VOL 99 No 20 ONE SHILLING



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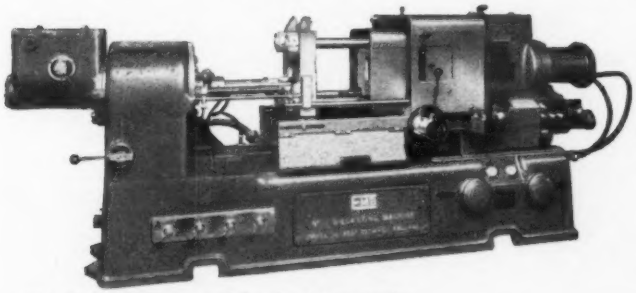

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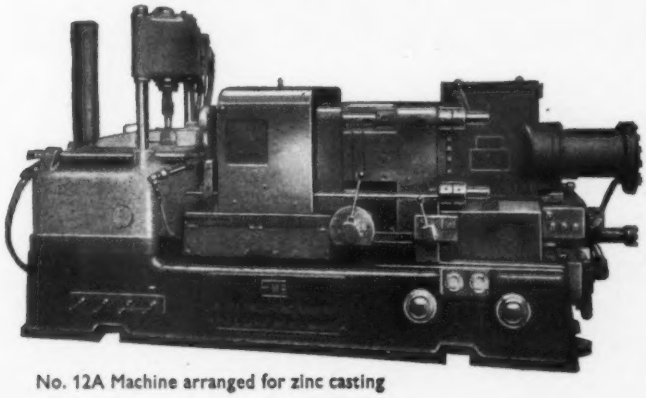

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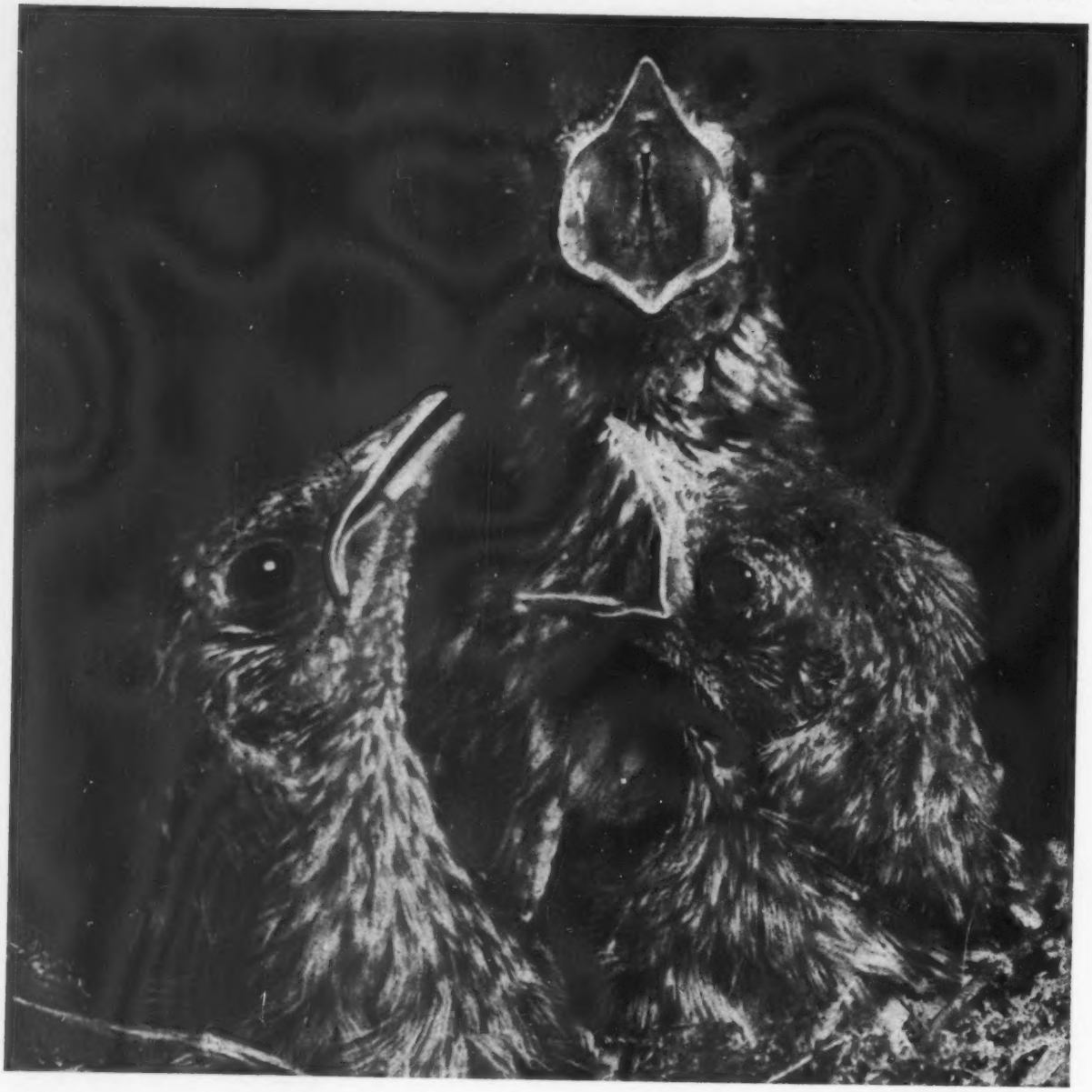

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METAL INDUSTRY

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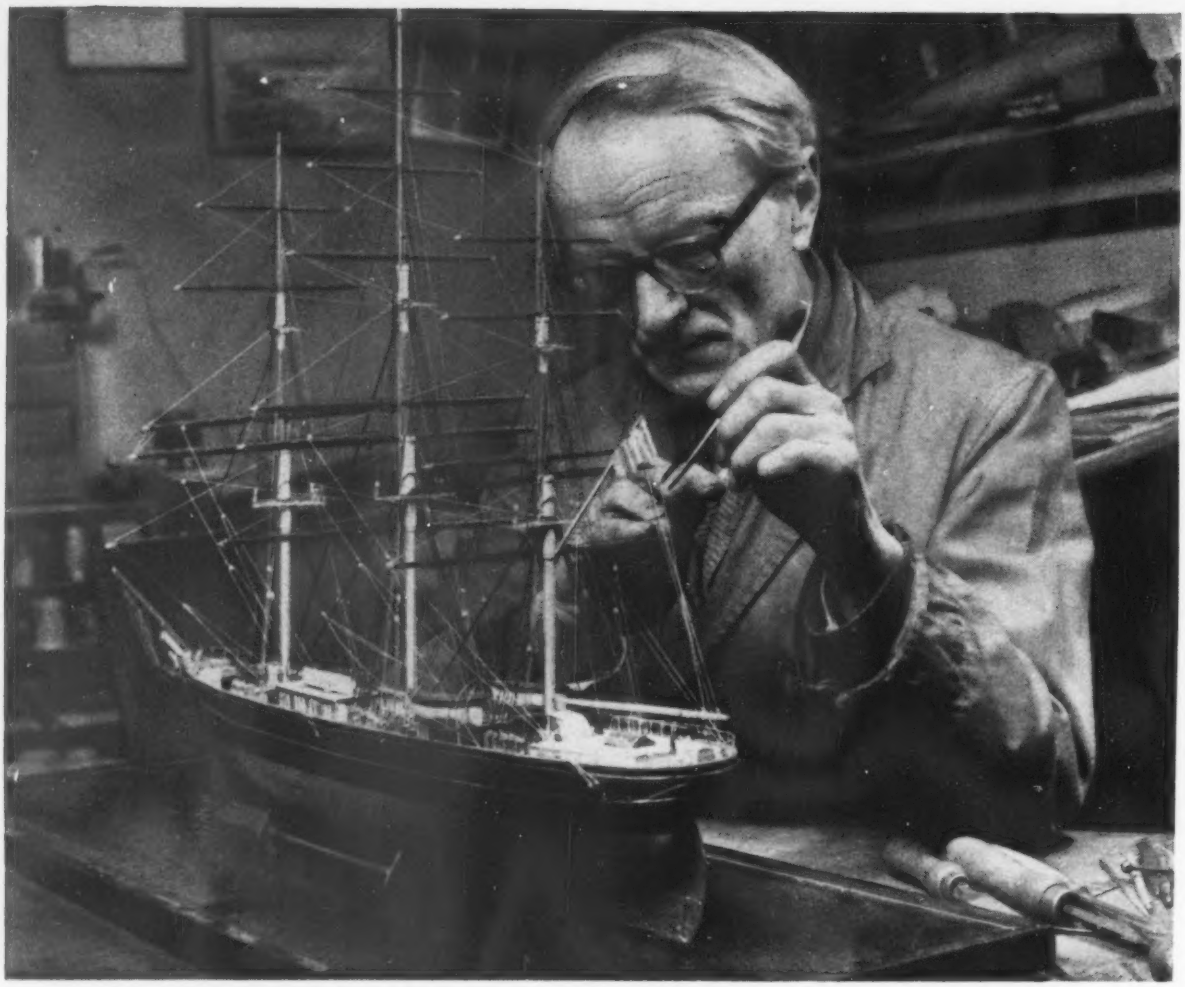

A master builder—a master craft

And a meticulous craftsman. His standards are high, and so must be the quality of the materials under his hand. He chooses them with the same creative care he lavishes on the work itself. The choice of metals for quality die casting is equally critical; that is why the leading die casters put their confidence only in Mazak.

In some cases the existing procedure of a producer is accepted as the best practice of the art and is taken as a basis for the standard in question. Thus British Standard 1004 (Zinc Alloys for Die Casting) was based on the established practice of the Imperial Smelting Corporation in the production of Mazak.

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METAL INDUSTRY

17 NOVEMBER 1961

VOLUME 99

NUMBER 20

Does It Pay Off?

AN economic and general assessment of the value of scientific and industrial research was given by Sir Harry Melville, Secretary of the Department of Scientific and Industrial Research, in a recent talk to the Manchester Statistical Society. He pointed out that in 1959 there were estimated to be 173,000 scientists and engineers, with graduate or equivalent professional qualifications, in employment or engaged on post-graduate research, an increase of 19·3 per cent over the corresponding figure in 1956. Although of these only perhaps one-third were engaged directly upon research and development work the others, engaged in administration, sales or education, were helping to develop the conditions and markets necessary for the work of research and development to flourish and be made effective. These figures offer a striking comparison to those of 1913 when, so far as can be estimated, there were only some 1,350 graduates employed on research and development, over half of them in universities. It is interesting, too, to note that total national expenditure on research and development increased some 40 per cent over the three years 1956-1959.

As to the question whether general expenditure on research pays off it should be noted that in the past decade it has been those industries based on science which have expanded most rapidly. Whereas production in manufacturing industry as a whole increased by less than 50 per cent between 1950 and 1960, production in chemicals, electrical engineering, and aircraft and vehicles, has nearly doubled. Again, goods with a high technological content play an increasingly important role in exports. Thus, in 1938, goods falling into the categories of chemicals and petroleum products, mechanical and electrical engineering and other manufactures of metals, scientific instruments, and aircraft and vehicles, accounted for about one-third of Britain's exports. By 1950 they accounted for about half, and by 1960 for nearly two-thirds of the value of exports.

Of the many examples quoted by Sir Harry illustrating that particular expenditure on the D.S.I.R. also pays dividends may be cited the detailed study carried out at the National Chemical Laboratory of ion-exchange equilibria and chemical process variables. This has been applied in research into the extraction and recovery of uranium from ores and has made it possible to produce metallic uranium at a cost much below that made by any alternative process. In turn, this has reduced the cost of nuclear-generated electricity. The study has also provided sufficient data to permit the accurate design, for a required production, of large-scale processing plants, without fear of over- or under-designing. During the recent building of an extraction plant, information available as a result of this research resulted in a capital saving of £750,000 on the plant which otherwise would have been constructed. Similar information also led to advice being given against the installation, at a cost of £300,000, of an innovation, later shown to be impracticable, at another uranium plant.

COPPER IN KATANGA

By G. Everwyn

COPPER was first reported by a Portuguese Governor of a Mozambique district in the year 1798. David Livingstone noted: "By smelting malachite, a copper ore, the natives of Katanga obtain large ingots in the shape of a capital I".

Belgian exploration of Central Africa commenced as from 1876 onwards, and during the years 1890 to 1892 expeditions under Le Marinel, Delcommune, Stairs and Bodson, Bia and Francqui, were sent to Katanga.

Of great value was the work of Professor Jules Cornet, the geologist, who accompanied the Bia-Francqui expedition in 1892 and described the mineral deposits.

In 1891, the Compagnie du Katanga was formed to organize all activities in Katanga. In the same year, this new company was granted large concessions by the Congo Free State (the later Belgian Congo). In 1900, the Congo Free State and the Compagnie du Katanga formed the Comité Special du Katanga and vested their interests in Katanga in this new body in the proportions: Congo Free State two-thirds, Compagnie du Katanga one-third.

In 1900, the Comité Special du Katanga granted prospecting rights in Southern Katanga to Tanganyika Concessions Ltd. In 1906, the Union Minière du Haut-Katanga was formed by Tanganyika Concessions Ltd., and the Société Générale de Belgique was granted the right to mine the copper deposits in an area of 7,700 square miles and the tin deposits in an area of 5,400 square miles, as well as other metals and useful substances, and to exploit the waterpower in Katanga. These concessions terminate in 1990.

The locations of the concession areas and the principal mining centres are shown on the map on page 396.

Principal Mining Centres

Elisabethville is the capital of Katanga. Founded in 1910, the town was intended to serve as administrative centre for the copper industry, then coming to life in Katanga. The first mine, "Star of the Congo", was established in 1910. It is no longer being exploited, but the old workings are still to be seen on the outskirts of the town. In the same year, work started on the Lubumbashi copper smelter. This smelter is still in operation and is now supplied mainly with ores from the Prince Leopold mine at Kipushi. The administrative offices of the Union Minière du Haut Katanga are in Elisabethville.

Jadotville, lying 87 miles north-west of Elisabethville, was founded in about 1917. Today, the mines near Jadotville have lost their former importance, the only mine having any significance being the extension to the old Kambove mine. The Shinkolobwe uranium mine was closed in May 1960. Jadotville is now mainly an industrial centre.

It is, however, of interest to note that the world's finest collection of mineralogical specimens of Katanga is in the Sengier-Cousin Museum of the Union Minière in Jadotville.

Kolwezi was founded in 1938 and has become Katanga's most important mining centre, the centre of the "New West", and the future of the mining industry. Most of the large opencast mines are here, and production capacity is rapidly being expanded.

Mining Products

Copper and cobalt are the principal products of the Katanga mines. A full list of the minerals found in Katanga, percentage of world production, and their principal use is given in Table I. (Those found elsewhere in the Congo have not been listed, except where specifically stated.)

At this stage it may also be mentioned that 60 per cent of the world's industrial diamonds are obtained from what used to be the Kasai Province and is now the "Etat Autonome du Sud-Kasai".

It was this mineral wealth which brought the early European explorers and pioneers to Katanga and which led to the development of the country; modern towns, roads, railways, mines and installations.

The principal copper mines of the Union Minière du Haut-Katanga are listed below (mines of lesser importance have not been included).

In all cases, the principal copper ore in Katanga is copper sulphide. Near the surface, this changes to copper oxide and copper carbonate (malachite).

Ore extraction of the copper and cobalt mines only totalled 6,481,000 metric tons in 1959 and 7,453,103 metric tons in 1960. The over-burden for the corresponding years was 19,881,000 and 16,100,000 cubic metres.

Mining production figures for copper and cobalt between 1951 and 1960 are given in the first section of Table II, and output of other mineral products, with total mineral exports for 1959 and 1960, are also shown.

Prince Leopold Mine is at Kipushi, 19 miles from Elisabethville. This mine is famous for its high grade

Part of the Musonoi workings near Kolwezi where copper and cobalt are mined

The importance of Katanga in relation to the Congo as a whole has been highlighted by the disturbances that followed the achievement of independence by the Congo. This article surveys the copper industry in Katanga, with which is closely related the world's largest cobalt mining industry, and indicates some of the current projects for expanding production

Inclined hoist installation at the Kolwezi mine

copper ore (10 per cent). Opencast mining began in 1926, but from 1930 onwards operations were carried on exclusively underground. There are four main shafts. This mine is now nearing the end of its useful life: 15 years for copper and 25 years for zinc. In addition to copper, zinc and other metals are obtained.

Ore production in 1959 was 956,956 metric tons, and 1,039,094 metric tons in 1960.

Kambove opencast mine is near Jadotville and supplies copper ore. Development is in progress (including shaft sinking). The ores are stockpiled for use in the concentrator now in course of construction.

Ore production was 203,317 metric tons in 1959 and 1,153,170 metric tons in 1960.

Shinkolobwe mine, which supplied radium, and later uranium ore (to the U.S.A. during World War II), became worked out and was closed down in May, 1960.

The Kamoto deposits are four miles west of Kolwezi and consist of copper and cobalt ores. This opencast mine is the most important mine in Katanga. Shafts are being sunk, at present, to mine the deeper levels. This mine is at present being "pushed".

Ore production reached 2,220,304 metric tons in 1959 and 2,073,908 in 1960.

Ruwe is nine miles north-east of Kolwezi and used to be a gold mine. Copper ore is found in the form of mineralized "breccia". The deposits are soft and are removed by draglines. The mine began to produce in 1940.

Ore production was 1,064,111 metric tons for 1959 and 1,276,084 metric tons for 1960.

Production at the Kolwezi opencast mine commenced in 1937. Copper and cobalt ores are found, and for 1959 and 1960 ore production was 67,413 and 662,821 metric tons respectively.

The Musonoi opencast mine is located two miles to the west of Kolwezi and has been worked since 1946, both copper and cobalt ores being found. This used to be a very important mine, especially as regards cobalt ore. In 1959, 1,757,681 metric tons of ore were produced, and 637,070 in 1960.

The relative values of the mining zones are (1960): Southern Group (Prince Leopold), 14 per cent; Central Group (Kambove), 16 per cent; and Western Group (Kamoto, Ruwe, Kolwezi, Musonoi), 68 per cent.

Principal Concentrators

The majority of ores are enriched by the flotation process.

Installed at the Prince Leopold mine is the Kipushi concentrator, which has a plant capacity of 100,000 metric tons of ore per month.

In 1960, 1,086,444 metric tons were treated in this concentrator.

Of the concentrates produced, copper forms the greater part, output being 272,476 metric tons (30 per cent) in 1959. For that year, the output of zinc was 117,778 metric tons (60 per cent), and lead-bearing concentrates totalled 178 metric tons.

In 1960, the corresponding figures were 232,646 metric tons (26 per cent), 193,004 (57 per cent) and 9,967 (34 per cent).

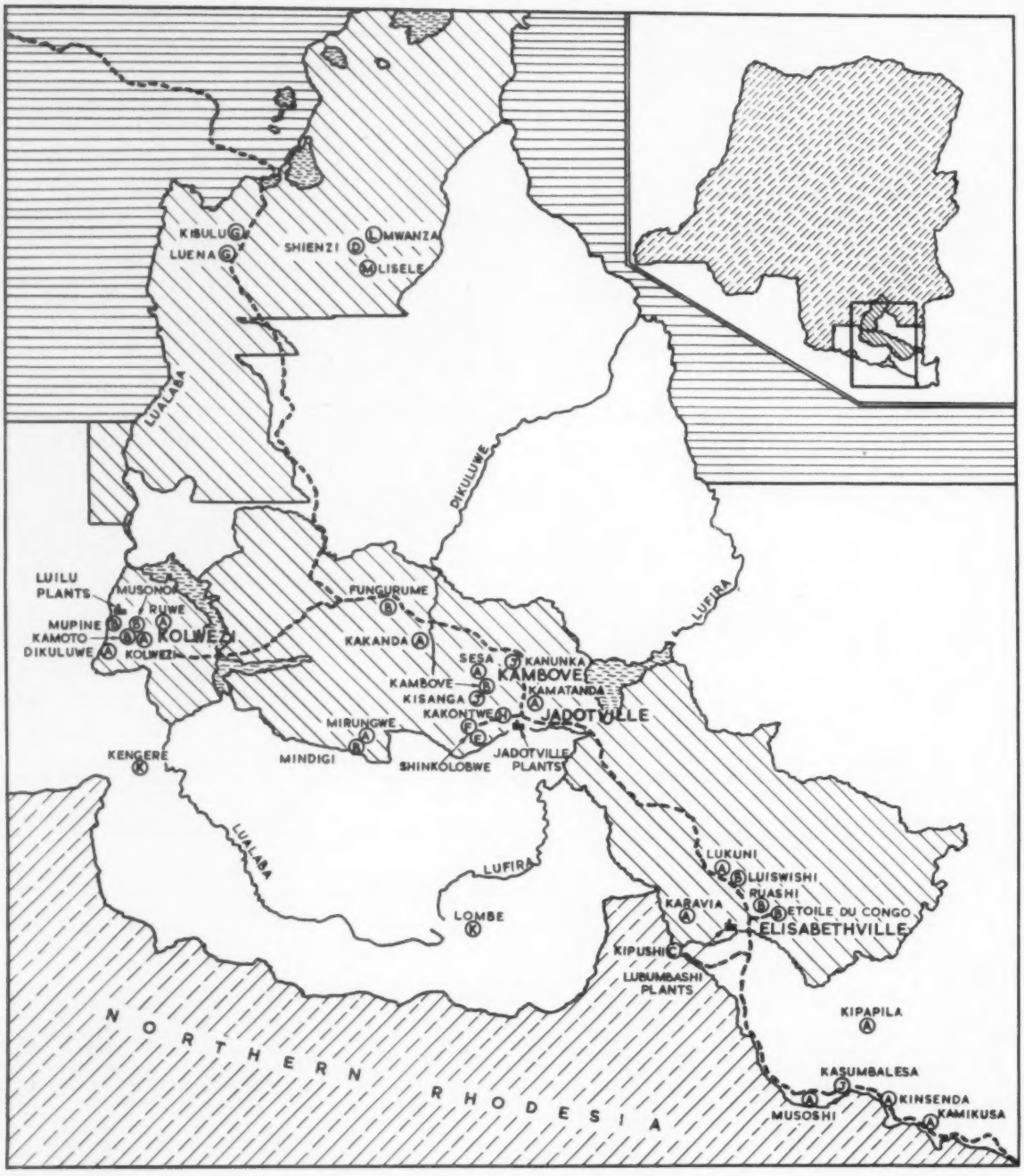
The new Kambove concentrator is in course of construction and will be commissioned this year (1961). The capacity is 60,000 metric tons of ore per month.

At Shinkolobwe, the concentrator and processing plant for uranium-radium ore (which had a capacity of 30,000 metric tons of ore per month), ceased

TABLE I—MINERAL WEALTH OF KATANGA

Mineral	Percentage of World Production	Mineral	Percentage of World Production
Cadmium	5·3	Radium	World's principal producer. 101·6 gm. 1959, 27·6 gm. 1960
Cobalt	60·0		
Copper	7·0-8·0		
Germanium	16·0	Silver	1·6
Manganese	3·0	Uranium	1,079 metric tons oxide 1960
		Zinc	3·9
Minerals of Minor Importance			
Iron	Not being mined extensively at present	Lead	—
		Platinum	900 gm. (1958)
Nickel	—	Palladium	4500 gm. (1958)
Other Metals, found both in Katanga and elsewhere in the Congo			
Niobium and Tantalum	16·0	Tin	8·5
Gold	45 kg. 1960 Katanga	Lithium	8·0

MINING AREAS OF KATANGA



A—Copper B—Copper and cobalt C—Copper and zinc D—Tin E—Uranium F—Precious metals G—Coal H—Calcium J—Iron K—Lead L—Graphite M—Manganese

– – – – Railways (in operation)

Map showing the locations of the major mining and metallurgical installations in Katanga. The areas shown diagonally shaded indicate the concessions held by the Union Minière du Haut Katanga, those in the north yielding mainly tin-bearing ores, those in the south having copper-bearing ores. In the inset at the top right hand corner these concession areas are shown in relation to the Congo as a whole.

TABLE II—KATANGAN MINING PRODUCTION

Year	Copper metric tons	Cobalt metric tons	Year	Copper metric tons	Cobalt metric tons
1951	191,959	5,715	1956	247,452	9,089
1952	205,749	6,813	1957	240,280	8,115
1953	214,116	8,278	1958	235,586	6,501
1954	223,791	8,609	1959	280,403	8,431
1955	234,673	8,567	1960	300,675	8,222

Other Products

Material	1959	1960
Cadmium	499 metric tons	505 metric tons
Germanium Metal (exported to Belgium as concentrates)	13,643 kg.	25,101 kg.
Gold	24 kg.	45 kg.
Manganese Ore 46-50 per cent	289,000 metric tons	342,000 metric tons
Radium	102 gm.	28 gm.
Silver	148,307 kg.	123,258 kg.
Uranium (oxide)	2,110 metric tons	1,079 metric tons
Zinc concentrates	95,598 metric tons	168,161 metric tons

Total Mineral Exports

	1959	1960
Minerals (metric tons)	730,295	864,711
Value (Belgian Francs)	—	about 10 billion
Value (Pound Sterling) £1=140 Francs	—	about 71 million

production when the mine closed.

The Kolwezi concentrator has a capacity of 330,000 metric tons of ore per month. It processes most of the Western zone ores. In 1960 some 3,872,052 metric tons were treated.

Output of copper and cobalt from the concentrator in 1959 was 665,412 metric tons, with an approximate metal content of 25 per cent copper and 1·4 per cent cobalt. In 1960, output was 741,491 metric tons, with 25 per cent copper and 1·3 per cent cobalt.

The Ruwe washing plant, for the Ruwe copper ore, has a capacity of 200,000 metric tons of ore per month. In 1960, 1,571,006 metric tons of ore were treated, yielding 202,344 metric tons of concentrate containing approximately 8 per cent copper. In the previous year, the concentrate totalled 343,076 metric tons, with 9 per cent copper. So far, the principal mines and concentrates have been discussed. The metallurgical plants will be described in the second part of this article, which also indicates the relationship of Katangan metal production to that of the rest of the world.

(To be concluded)

Chromate Coatings

A CHROMATING process suitable for large scale production has been introduced by The Pyrene Company Limited. The Bonderite '250' series of processes is designed to operate at room temperature and to produce on hot dipped galvanized steel, electro-zinc plated steel or zinc-based alloys, chromate coatings which give considerable corrosion protection. The coatings also form an excellent surface for subsequent painting.

The range at present consists of three processes. Bonderite '250' is specifically formulated to produce a colourless coating with reasonable corrosion resistance, that would be particularly useful for preventing "white rusting" of articles during storage, and in other circumstances where a coloured film is considered undesirable.

Colourless coatings are also produced by Bonderite '251', but with improved corrosion resistance. When submitted to salt spray tests this process showed a considerable increase in corrosion resistance over other colourless chromate coatings.

A heavier yellow-coloured chromate film with the high corrosion resistance associated with coatings of this colour, is obtained by the use of Bonderite '255'.

Ease of chemical control and low chemical costs are major advantages of this range of processes.

Reader's Digest

NICKEL-CHROME PLATING

"Nickel-Chrome Plating." *Published by Robert Draper Ltd., 85 Udney Park Road, Teddington, Middlesex. Pp. x+140. Price 25s.*

"AS PRODUCTS are improved, so the processes involved will become more complicated and, to some extent, more difficult to apply."

"This is an exciting, but difficult, time to be in the plating business."

"As most people who drive cars in the industrial cities are aware, the corrosive effects of smuts from industrial chimneys are very damaging (to chromium plated parts) in the winter."

The above three quotations are taken from the discussions on some of the four Papers presented at a one-day Symposium on Recent Developments in Nickel-Chromium Plating, which form the contents of this book. The meeting was organized by the London Branch of the Institute of Metal Finishing.

The effects of sulphur in the nickel deposit and contamination of the atmosphere by sulphur dioxide, and their effects on corrosion resistance of plated articles receive attention. Improvements in levelling, brightness, throwing power and testing are introduced in the first Paper, by H. C. Castell, of The International Nickel Co. (Mond) Ltd.

In the second Paper, given by S. W. Baier, of The British Non-Ferrous Metals Research Association, more attention is given to the developments of plating. Pore-free and crack-free chromium plating is very well surveyed.

The first two Papers, which are followed by some twenty pages of discussion, offer the reader some excellent data. Both Papers have references for further study.

The third and fourth Papers deal with "Acceptance Requirements", by W. G. L. Miller, and "Specification Requirements", by D. J. Bouckley, respectively. They deal principally with chromium deposits on steel, although other metals, including zinc die-castings, are also considered. Specifications and tests applied by The Ford Motor Co. Ltd. to ensure that chromium plated components are up to standard to ensure reasonable resistance to corrosive tendencies, are of interest.

An eight-page index provides a ready reference on "Recent Developments in Plating", e.g. plating solutions, barrel chromium, mechanical failures in chromium plated articles, corrosion resistance, non-destructive testing, jigging, anode-cathode distances, brittleness, defects, purification of solutions and many other everyday problems.

D. Ll.

OUT OF THE MELTING POT

Molten Plating ALTHOUGH hot-dip coating processes for metals have been, and still are, widely used and are yielding excellent results, there has, for many years now, been a definite trend away from such processes towards electroplating. In view of this firmly established trend, an encounter with a return to some of the conditions met with in hot-dip plating in a process of electroplating with molten metal naturally occasions some initial surprise. The process involves the electrodeposition of various metals and alloys with liquidus temperatures up to about 270°C. from plating solutions consisting of chloride or other halide salts dissolved in a high-boiling point polar organic solvent such as glycerol. The initial surprise soon disappears when one learns that metals and alloys electrodeposited in the molten state are smooth, dense and non-porous, and are free of occlusions or non-metallic constituents of the plating baths. These baths are effective fluxes for the basis metal to be plated, and thus ensure good wetting by the molten deposit. Because such molten deposits are dependent only on the composition and temperature, there is no need for the careful control of plating variables which is necessary in aqueous electroplating processes in which these variables have a decisive influence on the quality of the deposits. Limiting current densities, for example, are not determined by plating quality as in aqueous plating solutions where dendritic growths are formed at higher current densities. For this reason, extremely high current densities, of the order of 20 to 50 amp/cm^2, are frequently employed, resulting in extremely rapid plating, e.g. of indium or indium alloys at a rate of several mm/min., and permitting the co-deposition of metals widely separated in the electromotive series, e.g. indium and tin, which can be co-deposited in approximately equal amounts. Metals and alloys such as tin, tin-lead, lead-cadmium, lead-antimony and cadmium-zinc have been deposited. The process has so far proved particularly useful and versatile in the manufacture of transistors and the like. For example, the fluxing action of the bath makes it possible to deposit a metal or alloy in the form of an ellipsoidal bead on the end of a thin wire held vertically in the plating bath. A typical example is an ellipsoidal bead of eutectic indium-cadmium alloy, 0·1 mm. in diameter and 0·2 mm. long, which is deposited at the end of a 0·05 mm. nickel whisker in approximately 2 sec.

Unco-ordinated IS it lack of time, money, opportunity or interest that is responsible for research on the fatigue process in metals moving forward in the way it does? Somebody somewhere carries out some fatigue tests on single-crystal specimens of some metal or other and describes the microstructural changes observed. Elsewhere, somebody else investigates the influence on fatigue life of combinations of stresses and stressing periods that appear to border on the random, the results nevertheless being interpreted as yielding some information regarding "damage", "training" and the like phenomena. Elsewhere again, some results are obtained from fatigue tests in a vacuum, in dry or moist air, or with the specimens exposed to corrosive solutions. Elsewhere again, somebody finds that chromium plating of steel, or anodizing of aluminium, or the shot blasting of specimens, have certain effects on resistance to fatigue. Nowhere, however, has the attempt been made to collate all the work that has been done on fatigue during the past decade and to summarize all the conclusions that have been drawn from the results. Is it the lack of time, money . . . or is the prospect of the heterogeneous collection to be expected too depressing? However depressing on the one hand, such a survey, if compiled in a suitable manner would, on the other hand, provide the strongest possible evidence of the need for co-ordination of fatigue studies or, if this cannot be achieved, at least for continuity of individual studies, with more signs of awareness of the existence of other studies, of their findings and of their probable meaning in relation to the mechanism of the fatigue process.

Confusing a Principle CONVENTIONAL processes of manufacturing metallo-ceramic products entail various limitations. The factor mainly responsible for all this is the degree of dispersion of the constituents that can be obtained in conventional practice. The indications are that much higher degrees of dispersion would be beneficial, if only they could be obtained. In this connection the idea of using high-energy irradiation of a starting material to produce in it a finely dispersed second phase appears most interesting. Based on this idea, a process has been claimed for preparing metallo-ceramic compositions by irradiating one or more metal oxides, or a mixture of one or more metal oxides and one or more metalloid oxides with 100 to 400 million Roentgens per gram. The irradiation randomizes the crystals in such a manner that during subsequent sintering there is very little or no crystal growth, a high density and freedom from pores being thereby assured. The irradiation also partially reduces the metallic oxides to the free metal to a degree of from 0·5 to as much as 5 per cent. So far so good. Confusion sets in, however, when it is suggested that to promote this reduction, the oxide should be suspended during irradiation in water or a medium that is readily oxidizable, such as silicon dioxide and glycerol or sugar. The resulting radiation-chemical confusion is exemplified by the process in which a mixture of molybdenum sesquioxide, silicic acid and glycerol is irradiated with 100 million R/gm, a dark greenish-brown solution being obtained. This is mixed with 4 per cent lampblack and heated to 350°C., at which temperature it solidifies into a brownish-black mass, which is ground up, mixed with plasticizer and heated to 400°C. to form a solid, extremely hard plastics material that could be used as an insulator or semi-conductor.

Skimmer

Metalloceramics

RECENT WORK ON HIGH-TEMPERATURE REACTIONS BETWEEN REFRACTORY METALS AND CERTAIN OXIDES AND CARBIDES

LITERATURE on the subject of high - temperature reactions between refractory metals and certain oxides and carbides is limited, and conflicting opinions often appear. Recent work, carried out at the Institute of Metalloceramics and Special Alloys, Academy of Sciences (Ukraine), was directed at eliminating the confusion.[1]

The Russian Paper gives the results of an investigation of the contact reactions between BeO, MgO, ZrO_2 and the carbides MeC (zirconium, hafnium, niobium and tantalum) with the metals niobium, molybdenum and tungsten at temperatures of up to 2,100°C.

Chemically pure beryllia and magnesia were used, the zirconia was stabilized with calcium oxide; and carbides of zirconium, hafnium, niobium and tantalum had stoichiometric compositions; the refractory metals were of production purity.

A disc of the oxide or carbide was pressed on the specimen of refractory metal. Weighted with a rod, the assembly was then hot-pressed for 3-5 min. The resulting specimens were then held for 0·5 to 5 hr. in a vacuum furnace with graphite heaters at 1,000-1,600°C. to 2,100°C. After this soak, the ends were ground off and polished for metallographic investigation. The results are shown in Table I.

The interaction between the beryllia and niobium starts at 1,700°C., intensifying with rise in temperature. Above 1,800°C. on the boundary BeO-Nb, an alloy is formed and, depending on the distance from the border to the centre of the niobium rod, there are revealed grains of a new phase with a microhardness of about 600 kg/mm², apparently niobium beryllide.

Beryllia is resistant in contact with molybdenum up to 1,600°C.; starting at 1,700°C., along the contact line there is to be seen a weak formation of a new phase. It should be noted that, according to Johnson[2], the interaction of BeO with Mo begins at 1,900°C. Judging from the microhardness (1,000 kg/mm²), the new phase is apparently molybdenum beryllide and is revealed in the molybdenum rod at a depth of about 0·3 mm. from the contact line. The formation of the new grains proceeds near to pores in the molybdenum rod. The hardness of the molybdenum phase under these conditions is not altered, increasing only in the boundary layer to 280-290 kg/mm² in comparison with 220-230 kg/mm² in the centre of the molybdenum rod.

With tungsten, the beryllia shows marked reaction at 1,800°C., and the removal of oxides of tungsten, which gives rise to a very strong network of pores in the tungsten rod on the border with the beryllia. No new phase was observed, which is apparently due to the suppression of the reaction-forming beryllide by the high volatility of the tungsten oxides.

Magnesia in contact with niobium does not react before 1,900°C., after which it begins to react with the formation of a new phase, gradually spreading from quite a dense boundary layer into the depth of the niobium rod. The microhardness of this phase is only 1,850-1,870 kg/mm², the hardness of niobium both in the boundary layer and in the centre of the rod not changing and equalling 240-250 kg/mm².

Magnesia does not react with molybdenum and tungsten up to 2,000-2,100°C., and the microhardness of the metals, after heating in contact with MgO at these temperatures, does not alter.

The reaction between calcium-stabilized zirconia with niobium begins at 2,000°C., but at this temperature the reaction is weak. On the boundary there forms a very thin layer of a new phase with a microhardness of about 1,400 kg/mm², gradually spreading into the metal and possessing larger pores, particularly on the boundary.

Zirconia fails to react with molybdenum up to 2,000°C.; the hardness increases by a mere 20-30 kg/mm² on

TABLE I—REACTIONS BETWEEN METALS AND OXIDES

Contacting Materials	Reaction Time hr.	Temperature °C.					
		1600	1700	1800	1900	2000	2100
Beryllium Oxide							
Niobium	0·5	N	N	N	N	—	—
	1·0	N	W	S	S	—	—
Molybdenum	0·5	N	N	N	N	—	—
	1·0	N	W	W	W	—	—
Tungsten	0·5	N	N	—	S	—	—
	1·0	N	N	S	S	—	—
Magnesium Oxide							
Niobium	0·5	N	N	N	N	N	—
	1·0	N	N	N	N	W	—
	5·0	N	N	N	W	S	—
Molybdenum	0·5	N	N	N	N	N	—
	1·0	N	N	N	N	N	—
	5·0	N	N	N	N	N	—
Tungsten	0·5	N	N	N	N	N	N
	1·0	N	N	N	N	N	N
	5·0	N	N	N	N	N	N
Zirconium Dioxide (+CaO)							
Niobium	0·5	N	N	N	N	N	N
	1·0	N	N	N	N	N	N
	5·0	N	N	N	N	W	W
Molybdenum	0·5	N	N	N	N	N	—
	1·0	N	N	N	N	N	—
	5·0	N	N	N	N	N	—
Tungsten	0·5	N	N	N	N	N	—
	1·0	N	N	N	W	W	—
	5·0	N	N	N	W	W	—

N = No reaction; W = Weak reaction; and S = Strong reaction.

TABLE II—REACTIONS BETWEEN METALS AND CARBIDES

Contacting Materials	Reaction Time hr.	Temperature °C.						
		1000	1200	1400	1600	1800	2000	2100
Zirconium Carbide with Molybdenum	0·5	N	N	N	N	N	N	N
	1·0	N	N	N	N	N	N	N
	2·0	—	—	—	N	—	N	S
	5·0	N	N	N	N	N	S	—
Hafnium Carbide with Molybdenum	0·5	N	N	N	N	N	N	—
	1·0	N	N	N	N	N	N	—
	2·0	N	N	N	N	N	N	S
	5·0	N	N	N	N	N	S	—
Niobium Carbide with Molybdenum	0·5	N	N	N	N	N	N	N
	1·0	N	N	N	N	N	N	S
	2·0	—	—	—	—	N	W	N
	5·0	N	N	N	N	W	S	—
Tantalum Carbide with Molybdenum	0·5	N	N	N	N	N	N	N
	1·0	N	N	N	N	N	N	N
	2·0	N	N	N	N	N	N	N
	5·0	N	N	N	N	N	N	N

N = No reaction; W = Weak reaction; and S = Strong reaction.

the boundary. The reaction with tungsten begins at around 1,900°C. With this again, there forms a porous structure in the contact layer of the tungsten rod with a hardness of up to 960 kg/mm², in comparison with 380 kg/mm² in the centre of the metal rod.

The results of the experiments concerned with the contact layers of carbides of zirconium, hafnium, niobium and tantalum with molybdenum are given in Table II.

Up to 1,800°C. there are no signs of reaction between zirconium carbide and molybdenum. At 2,000°C. (5 hr. soak) there is a weak reaction with the formation of a new phase, distributed in a thin layer along the contact line. At 2,100°C. the reaction markedly accelerates, and after 2 hr. of contact there forms a layer up to 1·5-2 mm. thick with a microhardness of about 720 kg/mm², which corresponds to a solid solution of carbon in molybdenum.

No reaction between hafnium carbide and molybdenum occurs up to 2,000°C., after which a reaction begins with the formation of a new phase with a microhardness of about 1,200 kg/mm², which approximates to the hardness of Mo_2C on the lower boundary of the homogeneity region. The hardness of molybdenum in the centre of the rod scarcely alters (194 kg/mm²), but on the boundary with the new phase equals up to 240 kg/mm², which is due to the formation of a low-concentration solid solution of carbon in molybdenum. The new phase is distributed quite deeply in the molybdenum rod.

A weak reaction of the niobium carbide with the molybdenum is observed only at 1,800°C. with a 5 hr. soak, but developing strongly at 2,000°C. The hardness of the molybdenum in the centre of the rod again is scarcely altered, but on the boundary increases to 240-250 kg/mm² The resulting new phase has a relatively low hardness of the order of 690-720 kg/mm², which cannot be called a carbide phase, and is better called (as in the case of the system ZrC-Mo) a solid solution of carbon in molybdenum, niobium or an alloy of niobium with molybdenum. This phase does not penetrate inside the metal, but forms a porous layer on the contact boundary.

With the contact of tantalum carbide and molybdenum, there is no reaction up to 2,100°C., the hardness of the metal on the boundary with the carbide remaining unchanged.

These observations are useful for practical purposes. It is necessary to carry out further studies of the mechanisms occurring with the interaction of the above metals and compounds, with the aim of explaining the nature of the developing phase, and to explain the nature of the diffusion processes and the basis of thermodynamic relationships, etc.

Conclusions

The most resistant metal in contact with BeO is tungsten; with MgO—molybdenum and tungsten; with stabilized zirconia—molybdenum.

The most resistant carbide in contact with molybdenum up to 2,100°C. is tantalum carbide; the interaction of molybdenum with the carbides of zirconium, hafnium and niobium begins at 1,800-2,000°C.

References

1 G. V. Samsonov, *et al*; *Ogneupory* (Refractories), 1961, No. 7, 335-338.

2 P. Johnson; *J.Amer.Cer.Soc.*, 1950, **33**, No. 5.

Cutting Large Aluminium Billets

SCRAP aluminium billets, each 24 ft. long, 3 ft. in diameter and weighing about 12 tons, were recently cut to furnace size by thermic boring at International Alloys Ltd., Aylesbury.

With this process, the job was carried out more quickly and economically than by mechanical methods such as sawing. Because of the size and weight of the billets, mechanical cutting would have meant installing expensive equipment and greatly increased material handling costs.

Each billet was cut into three sections, and each cut took an average of about 22 min. The work was carried out by operators specially trained by British Oxygen.

Thermic boring process being used for cutting large aluminium billets, 24 ft. × 3 ft. in diameter

Die Design for Gravity Die-Casting

By W. Goode

(*Birmingham Aluminium Casting (1903) Co. Ltd.*)

(*Concluded from* METAL INDUSTRY, 10 *November* 1961)

WITH complex jointing, the designer may often be tempted to carry the outside form straight into the riser or runner without a step, in view of the great potential simplification of such jointing and/or the simplification of a difficult machining operation, but the needs of the foundry and its ancillaries must be served first, particularly in this process, where the mould productivity ratio is so high.

Mitigation of these problems comes indirectly in no small measure after consideration of the fact that in casting the riser cavities have to be maintained at a greater temperature than the impression cavities, as explained earlier, and in order that the warpage experienced in the former shall not be transmitted to the latter, the mould is split. The most effective and usually most convenient line is at the step desired to discriminate between the mould cavity and the risers.

In point of fact, the designer should not hesitate to split the mould in as many places as possible, with subsequent bolting and dowelling as necessary, if it simplifies machining, since excellent means of venting are again provided in company with a corresponding diminution in warpage potential wherever applied. This is not to say that the number of units in the die must not be kept to an absolute minimum, so reducing foundry maintenance, and assisting rapid production, another point on which the product designer can be of great assistance.

In addition to ensuring that all units of a die are tightly clamped to their respective counterparts during pouring they must be accurately positioned one to the other. Fortunately, in this process, location here is necessary only in two directions for the majority of units, vertical location being satisfied simply by gravity and the work table either directly or indirectly. Therefore, it will not be surprising that the most satisfactory method of location has been, and continues to be, the interposition of a plain key, rectangular in section and long in proportion to its depth of engagement, between the units (see Fig. 11).

Previous diagrams have not included these keys for obvious reasons. Care must be taken that there is sufficient lead on the flanks of the keys to ensure easy engagement, and reference is, of course, to the line of draw of the particular unit, often predetermined by design and when not so, equally as often confined within narrow limits, either by the casting geometry or by the necessity of being the first unit to be drawn of a trio, the planes of the two joints concerned diverging at a very small angle, or a combination of both.

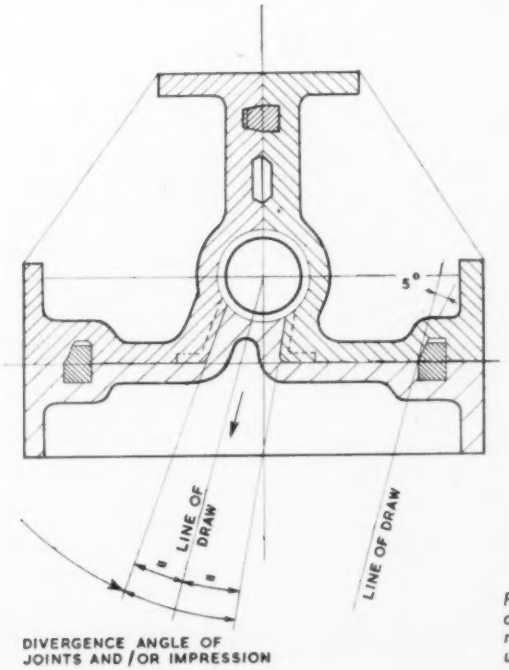
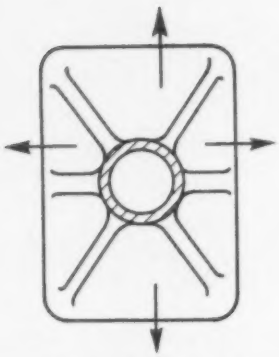


Fig. 11—For locating the halves of a die accurately, plain rectangular keys are frequently used

A type of die with distinct advantages over the plain two part die, depicted in diagrams previous to Fig. 11, is what is known as the book type of die, where clamping takes place on one side of the die only. The die is a fixture on a base in that its members can only be rotated about a pillar mounted on that base, the pillar occupying roughly the position of the deposed clamp, the die opening and closing like a book. Casting geometry again is the deciding factor in its adoption; often a most insignificant amount of malformation will swing the balance in favour of a book die. The advantages are felt in more rapid production because clamping and unclamping operations have been halved and the blocks are always in the same close relationship and in a set position on the table fostering a more definite rhythm of manoeuvre.

Venting at die splits, touched upon earlier, can take the form of generously proportioned grooves, extending from the impression along one or other of a particular pair of mating faces to the outside of the die and atmosphere, possible because of the slow filling of the mould and low pressures of the process.

The article portrayed in Fig. 11, nesting in a three-part die, embodies the rudiments of many. The conjecture is that the product designer initially required a sleeve, followed by a desire to attach it to some other component of an array. Not thinking in terms of a die-casting, a drawing would be prepared, let us say, for production from tubing, with brackets welded on to be subsequently drilled for fixing bolts. Later, perhaps, after proving, the designer, being doubtful of supplies at a rate to keep pace with demand, would submit the self-same drawing to a gravity die-casting foundry for production from a permanent mould. Had the drawing been re-appraised with the new method of production in mind and



Left: Fig. 12—Numbers and placing of webs may involve additional die members and this should be avoided where possible as indicated by the lower of the two diagrams

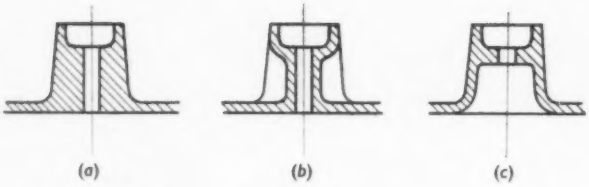
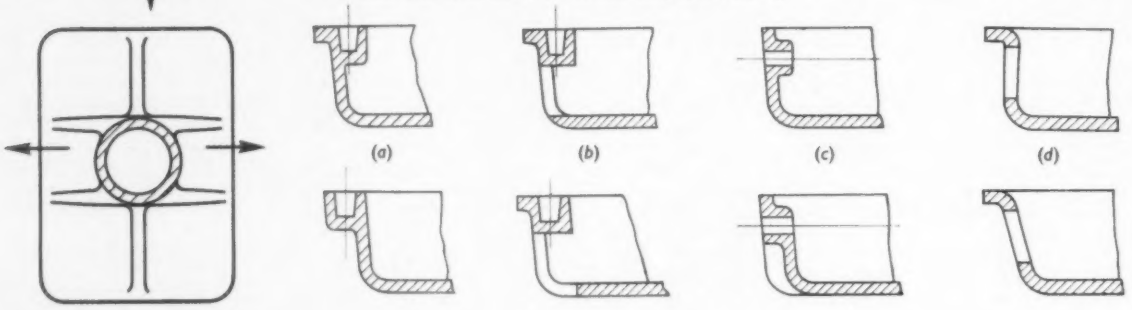


Fig. 13—Two methods of lightening a section (a) as called for, (b) and (c) alternative improvements

Fig. 14—Thoughtful modification of design can frequently avoid undercuts in the die. In the diagrams below, the lower sketch has been modified in each case from that above it, improving the design characteristics without impairing the serviceability of the casting



collaboration in design sought with the foundry, undercuts necessitating a three unit die could probably have been removed, and a two-part die substituted.

Instances of this nature are often trapped in the die design office and joint efforts directed towards modification of the article are initiated at that end. If the product designer should consider it expedient as a policy to rely on his supplier for help in this way, large or small, a considerable handicap for the die designer would be removed. Needless to say, much correspondence would be avoided if, in addition to a component drawing, he should receive a layout showing the position of the article in relation to other components of the array, including an indication of its function.

It is not uncommon for prototypes to be sand cast and points to be remembered when contemplating a permanent mould include a re-examination of all faces currently machined with a view to reducing the amount of metal to be removed or, in some cases, the "as cast" condition will be found to be completely satisfactory. The general metal thickness can also be reduced in many cases, and draft required in both processes can be reduced when gravity cast, because of the more rigid mould. Reversal of the taper is also a possibility, due to a re-arrangement of parting lines occasioned, amongst other things, by differing runner techniques and, more predictable to the product designer, the consideration of the formation of the moulder's prime tools.

On the one hand, there is the reproduction of the article in wood, an easily workable material, and, on the other hand, there is the female reproduction, to be machined in two or more metal parts where careful study can save many hours of machining time. Neither process is very greatly concerned with the aesthetics of a product, but a closer examination of what is functional and what is not, can pay dividends in reducing machining time of the metal impressions. The same can be said with regard to the complete sub-assemblies, consisting of pressings and turned parts welded or riveted together, which can be replaced by one gravity casting. Features in the former, if not functional, should not be retained if such action will ease machining of the die and/or promote the production of sound castings by allowing a gentle transition from a light section to a heavier section. Features, however, may be added with benefit both to the strength of the component and, if properly designed, to the productivity of the die.

Webs are the main contribution here, but webs intersecting at an acute angle must be avoided because of the weakness created in the die accompanied by a local hot spot, difficult to cool; and note should also be taken of previous remarks concerning the limiting of the number of units in a die. A condition where ribs can result in extra members is shown in Fig. 12. In the one case, the disposition of the ribs makes four die members necessary, but in the other, it will be seen that two are sufficient. Webs can also be the means of reducing local heavy sections; so, also, can pockets, the choice often depending on which die member it is most convenient to machine, or on ease of die operation. Two such alternative methods of lightening out are shown in Fig. 13, (a) being as called for, (b) and (c) the alternatives; either may form an undercut to the relevant parting line, making the choice obvious.

On the subject of undercuts, the top sketches in Fig. 14 show four features of component design with an alternative below. In each case, a uniform metal thickness has been maintained and the use of a collapsible core or additional moving die member has been avoided. Note particularly in diagram (d) how extra taper on a wall can make the production of windows in a casting possible with half formed on the main core and the rest on the member forming the outside shape.

Obituary

Dr. Edwin Gregory

WE deeply regret to record the death of Dr. Edwin Gregory, M.Sc. (Lond.), Ph.D., A.Met., M.I.Chem.E., M.I.E.I., F.I.M., F.R.I.C., who had been a director of Edgar Allen and Co. Ltd. for 15 years and chief metallurgist from 1944 until his retirement from executive duties in March 1961.

After leaving the University of Sheffield, he was with Kayser Ellison and Co. Ltd. for some 12 years, joining the Metallurgical Department at Sheffield University in 1921. In 1937, he became chief metallurgist at the Park Gate Iron and Steel Co. Ltd., and in 1943 he was made head of the Metallic Materials Section of the A.I.D.

He had published a number of books and Papers, was a Member of the Council of the Royal Institute of Chemistry; Founder-Fellow and former Vice-President of the Institution of Metallurgists, and was chairman of the B.I.S.R.A. Standard Methods of Analysis Committee.

New Plant and Equipment

Flash Welding

RECENTLY introduced by Electro Mechan-Heat Limited, Manor Works, Ettingshall, Wolverhampton, Staffs., the BAJ.32/120 flash welding machine uses "Alligator" clamping with a special air/hydraulic system which gives high speed closing of the jaws, whereafter pressure is built up until a maximum clamping force of 24 tons is achieved.

Both the table and the swivelling upper jaws are cast in high tensile steel, and are sufficiently robust to withstand all clamping forces, the main frame of the machine (a fabricated mild steel assembly) being required only to provide general support for the equipment and to resist longitudinal forging forces of up to 12 tons.

A specially shaped arm contour makes the machine particularly suitable for use on cylindrical components, such as wheel rims and small barrels. The maximum weldable cross section is 2·33 in^2. The maximum width of strip which can be accommodated between the arms is $11\frac{3}{4}$ in. At this width, cylindrical components down to $13\frac{3}{4}$ in. in diameter can be welded, while at widths below $4\frac{3}{4}$ in. the component's diameter can be as low as $9\frac{3}{4}$ in.

The high clamping and forging pressures are obtained by means of an additional ram which comes into operation to intensify the hydraulic pressure as soon as the primary ram has completed its stroke and closed the clamps. The moving table is air/hydraulically operated, so that the extent of its travel can be accurately set over a considerable range of movement. Forging pressure can be applied at any point.

The whole welding operation, including the movement of the table, can also be controlled manually. There are foot-switches by means of which each clamping jaw can be closed independently.

All areas likely to be affected by weld flash are protected by thick copper screens, from which any steel particles can easily be removed during cleaning.

Billet Shearing

BY the use of electro-hydraulic actuation, a new design of billet shear by Joseph Rhodes and Sons Limited, Grove Ironworks, Wakefield, Yorks., gives entire protection from damage by overloading, at the same time enabling any job to be tackled with complete safety to the operator. The hydraulic gear is pneumatically controlled; a pressure relief valve in the hydraulic circuit prevents overloading and risk of damage to the machine. In respect of safety and reliability the machine is, therefore, far superior to the orthodox crank-operated shear.

Substitution of castings by fabricated steel gives a modern, clean design and not only makes for extremely simple construction, but also enables these machines to be built as required to meet customers' exact specifications. Exceptionally long slideways ensure precise alignment of the ram, and prolonged blade life. Maintenance costs are, therefore, at a minimum.

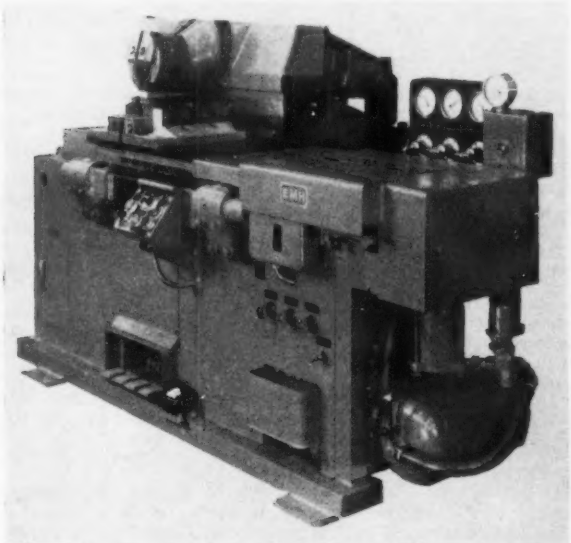
Though primarily designed as a billet shear, the design is flexible and can be arranged as a robust hydraulic double-sided press at little or no extra cost.

The machine, shown in the accompanying illustration, has a stroke of 5 in. and will take 12 in. by 1 in. billets, with a pressure of 150 tons, single or continuous stroking. Dimensions: height 8 ft. 3 in.; front to back, 3 ft.; left to right, 5 ft. 6 in.; weight, 5 tons. Blades have jaw cutting edges.

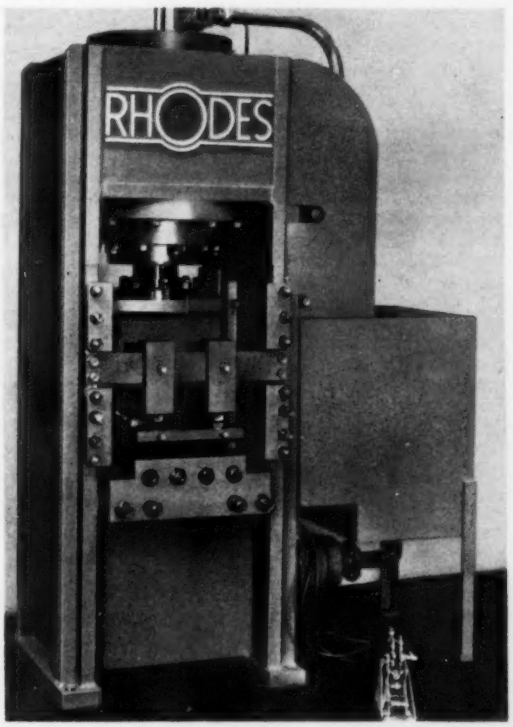
Vacuum Sintering

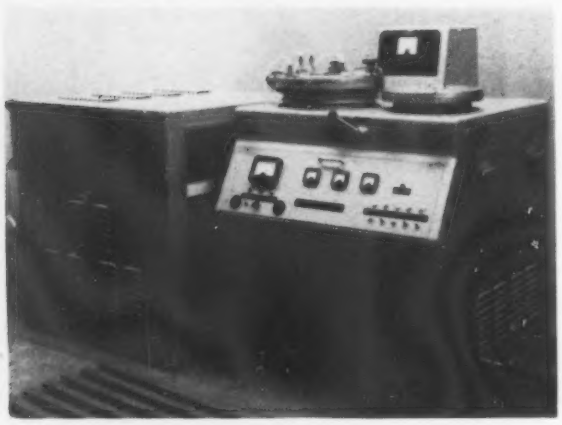
TWO versions of a high vacuum sintering or heat-treatment furnace have recently been developed by Vacuum Metallurgical Developments

Below—The BAJ 32/120 flash welding machine introduced by Electro Mechan-Heat Ltd.



Right—Electro-hydraulic billet shear by Joseph Rhodes and Sons Ltd.





The manual version of the vacuum sintering and heat-treatment furnace introduced by Vacuum Metallurgical Developments Limited

Ltd, of Alma Works, Manchester, 19.

One of these is manually controlled, and the operation cycle is as simple as possible, in that the charge is loaded on a tiered tray assembly and placed in the chamber, the charging cover replaced, the vacuum system brought into action, and, finally, the resistance heater switched on. The operating temperature can be as high as 2,400°C. at pressures better than 10^{-5} mm/Hg. Such furnaces are currently sintering tantalum capacitors for manufacturers in the United Kingdom.

The heating element, fabricated from tantalum or tungsten sheet in three segments, form a circle $3\frac{7}{8}$ in. diameter by 15 in. long, each segment being riveted in turn to tantalum or tungsten sheet conductors leading to connections on the bus bars.

Radiation shields fabricated from tantalum sheet are again in segments and form a complete enclosure around the element. The entire assembly is held by tantalum nuts, screws and spacers, thus eliminating the use of troublesome refractories.

The element and radiation shield assembly is readily detachable from the chamber—simplifying replacements and cleaning.

The entire unit is enclosed in a steel cabinet attractively finished in stove grey enamel.

Transformers housed in a second cabinet supply power to the heating element, variation being provided by an auto transformer controlled by a rotary switch or core reactor system.

Safety interlocks protect against water failure, and independent fuses to each main component are fitted as standard equipment on both versions of the furnace.

The second version is similar in design but embodies semi-automatic controls.

A multi-position rotary switch ensures correct sequence, each position being clearly marked, and overriding switches enable any individual operation to be accomplished without the use of the sequence switch.

A sequence switch is again provided for the first stage of the operating cycle, but the heating control can be slaved to the pressure instrumentation, incorporating the latest techniques to ensure the longest possible life of the rare metal elements and radiation shields, as well as allowing the plant to be operated by a semi-skilled operator. Outgassing rate is automatically controlled by presetting the pressure gauge at the required level, the rate of heating being then controlled so that the pressure never exceeds the gauge setting.

MEN and Metals

Changes just announced within the technical directorate of the British Standards Institution should enable it more efficiently to meet a rising demand for standards from an ever-widening circle of interests and to cope with the greatly increasing weight of international standards work. **Mr. Gordon Weston** (technical director) has been appointed associate director of the institution; **Mr. J. F. Stanley,** previously divisional chief technical officer for electrical and related projects, is appointed deputy technical officer (electrical); **Professor C. A. Geneve,** the divisional chief technical officer in charge of codes, personal safety, metallurgical and other standards work, is now appointed technical adviser (special duties) and will be primarily concerned with developing standards projects for refrigeration, shipbuilding and structural work. Five former senior technical officers are now promoted to divisional chief technical officers as follows: **Mr. R. Berry, Mr. P. Bingley, Mr. J. Brown, Mr. R. A. McKinstry** and **Mr. A. F. B. Nall.**

News from the Brookside Metal Company Limited, of Watford, is that **Mr. D. W. Hartnell** has resigned from the board of the company.

Appointed President of the Welded Tool Manufacturers' Export Association, and of the Welded Tool Manufacturers' Association in succession to **Mr. R. P. Wallace,** of Jessop-Saville Limited, **Brigadier A. Levesley,** O.B.E., M.C., T.D., M.I.Mech.E., is a director of Edgar Allen and Company Limited.

It is announced by Causeway Reinforcement Limited that **Mr. J. Stapleton-Barron** has been appointed sales manager of the tubular division of the company.

A solicitor and partner in a City of London firm of solicitors, **Col. Alan Randall Rees-Reynolds,** C.B.E., T.D., has been elected to the board of Pollard Ball and Roller Bearing Company Limited.

Another stage in the B.S.A. group's policy for strengthening local management and giving operating companies greater responsibility was announced last week in the formation of two new divisions — General Engineering and Metal Components. Each has a divisional board and comprises four companies. **Mr. A. J. Burton** has been appointed managing director of the general engineering division, which comprises B.S.A. Guns Ltd., Carbodies Ltd., Monochrome Ltd., and a new company, B.S.A. (Redditch) Ltd.

The four companies of Metal Components Division are: B.S.A. Metal Powders Ltd., B.S.A. Sintered Components Ltd., B.S.A. Precision Castings Ltd., and Idoson Motor Cylinder Co. Ltd. **Mr. R. F. K. Belchem** has been appointed managing director of this division.

In view of the rapidly expanding standard steel building division of Sanders and Forster Limited, the structural company of the Chamberlain group, they have appointed **Mr. Ronald W. Abel** as home sales manager of the division.

For the past two years a director of Firth Cleveland Steel Strip Limited, **Mr. Kenneth A. Smith** has been appointed a director of Firth Cleveland Steel Limited, and of the associated company, J. J. Habershon and Sons Limited. Mr. Smith joined the Tipton company in 1949 as a metallurgist. In 1955 he was made works manager, and in 1959 became production director.

Joint managing director of Expandite Limited, **Mr. T. Pooley** is to make a tour of Pakistan, India, Singapore, Malaya, Australia and New Zealand.

Industrial News *Home and Overseas*

Aluminium in Australia

According to news from Melbourne, Alcoa of Australia Pty. Limited has speeded up its plans to establish a £A44,000,000 integrated bauxite-aluminium project in Western Australia and Victoria. It is now planned to commence operations in 18 months' time—about mid-1963, it was stated. This is at least six months ahead of the originally announced starting date of 1964.

German Export Duties

Some quantities of aluminium, copper, lead and zinc scrap have been freed of export duties by the West German Ministry of Economics for a period of two months, the Official Gazette announced last week. This is conditional on the scrap being sold only to partner countries of the European Common Market. V.W.D., the West German economic news agency, commented that the reason for the measure is to gain experience of the effects of articles 16 and 34 of the E.E.C. Treaty, which provides for complete cancellation of export limitations within the foreseeable future.

For Scrap Metal Dealers

Among the latest vehicles produced by **Pilot Works Ltd.** is the 7½ yd³ capacity tipper designed specifically for scrap metal haulage. The vehicle is based on the Bedford TK long wheelbase chassis with forward control, and has been fitted with 'Pilot' OV.3 tipping gear and an all-steel, electrically welded 'U' shaped end tipper body. Because of the arduous nature of the duties for which it was built, the sides, floor and loading board have been constructed in heavy $\frac{3}{16}$ in m.s. plate. The taildoor, however, is in 14's m.s.s. to facilitate lifting.

Tretol Epiflor

It is learned from **Tretol Limited** that their "Tretol Epiflor"—the trowel-applied oil- and acid-resistant floor topping—is now available in two grades. The manufacturers have developed a special heavy duty grade, which is designed particularly for use where the flooring must withstand extremely hard wear from trucking. The new grade retains the excellent resistance of the standard grade to oils and acids, etc., both grades being completely non-slip.

The standard colour range of Tretol Epiflor has now been widened to include a dark grey shade. It is understood that this product is currently being used in many factories, plating shops, garages, etc., where new areas can easily be laid by the maintenance staff without holding up production.

Electroplating News

A series of news sheets giving details of the new developments in the equipment and materials that are being offered by **W. Canning and Company Limited** has just been issued. These include the following items: (a) universal stripping salts for steel (formerly electrolytic nickel stripping salts); (b) passivation processes for zinc and cadmium electrodeposits; (c) "Hybrax" bright nickel barrel plating solution; (d) Coolair bias Stapol/Sisal mops; (e) additions to their range of barrel plating equipment; (f) colourless passivation of copper and brass, and (g) a new cleaner—"Jewellax" soak cleaner, developed primarily for jewellery.

Each sheet contains a comprehensive description of each item, including, in some cases, illustrations.

Scrap Metal Quotas

Despite misgivings about the policy governing non-ferrous metal prices in Italy, the E.E.C. Commission has decided to again allow duty-free non-ferrous metal scrap quotas for dealings within the E.E.C. area.

The following quotas have been fixed for shipments between E.E.C. countries during the fourth quarter of this present year (in metric tons):

Belgium, copper 225; lead 400; aluminium 430. West Germany, copper 2,230; lead 1,050; zinc 1,325; aluminium 1,145. France, copper 940; lead 720; zinc 840; aluminium 840. Netherlands, copper 225; lead 200; aluminium 105. Italy has no quota because her non-ferrous metal exports are already fully liberalized.

Bauxite in Sierra Leone

A 15-year bauxite mining concession in Sierra Leone has been granted to the Swiss company, A.I.A.G., Aluminium Industrie AG, of Zurich. Mining is to start in 1963. The deposit is expected to yield 100,000 tons of bauxite annually. The Sierra Leone Ore and Metal Co. Ltd., set up in Freetown, will be in charge of the preparatory work.

Materials in Space Technology

A Symposium on materials in space technology organized by the **British Interplanetary Society** is to be held on Wednesday next, November 22, in the Lecture Theatre of the Royal Aeronautical Society, London, commencing at 9.30 a.m. There will be a morning and afternoon session, the latter commencing at 2.30 p.m.

Among the speakers will be Prof. A. J. Murphy ("A General Survey of the Materials Problem"); Dr. E. F. Emley ("Magnesium in Space Flight"); Dr. E. G. West ("Aluminium and Its Alloys"); Mr. R. K. Hurden and Mr. A. E. White ("Use of Graphite Materials in Aerospace Technology"); and Dr. R. S. Barnes ("Effect of the Radiations Encountered by Materials in Space").

Safety Measures

Some machines such as spot welders, guillotines, X-ray plant, etc., can become dangerous if started accidentally by inadvertent operation of a switch. To minimize this danger, **Herga Electric Limited** have extended their range of foot switches, to include models with effective toe-guards.

To operate the switch, the foot must first be inserted under the guard, and the chance of accidental operation is reduced to the minimum. Various contact arrangements as in standard Herga foot switches are available in the new models, and these cater for loads up to 15 amp. or 3 h.p., either single-, double- or triple-pole. Switches with two or more circuits closing in sequence can be provided, as well as other special arrangements to suit customers' individual needs.

Zinc Disposals

It has been announced by the Board of Trade that they are offering for sale by tender about 880 tons of zinc for delivery and pricing between December 1961 and April 1962. All the zinc is high grade or special grade. Tender forms will be available in a few days' time from E.I.D. (4), Board of Trade, Lacon House, Theobalds Road, London, W.C.2.

A Pressurized Container

From **Solus-Schall Ltd.** comes a new type of pressurized container, the Flexi-Spray, to spray their Spotcheck penetrants, Zyglo fluorescent penetrants, magnetic inks and associated materials on to specimens for the detection of cracks, flaws and other defects.

This new spray consists of a power unit containing a gas propellant; a separate storage unit to contain the material to be sprayed; and a plastics moulding with valve mechanism which fits both these units. The spray permits any number of materials to be sprayed in any order with one and the same power unit; it is also understood that solid materials in suspension can be sprayed without danger of valve blockage; materials of high velocity can be handled efficiently; and penetrants can be purchased in bulk quantities at economic rates, the power packs being easily replaced as required.

The complete unit is priced at 35s. and replacement power packs at 7s. 6d. each. A 14 oz. power unit is said to spray about 20 fluid oz. of a liquid whose viscosity is similar to that of high-grade kerosene which is used with magnetic materials. This amount will decrease as the viscosity of the material used increases.

Silicates Industry

All developments in the silicates industry, both at home and abroad, are to be covered in abstract form in the *Silicate News*, the first issue of which has just been published by **Joseph Crosfield and Sons Ltd.** New products based on silicates are to be discussed, patents and patent applications will be reviewed, long-term research projects will be reported on, and each issue will spotlight one important or unusual use of silicates.

Furnace Installation

At the British Transport Commission's railway works, Crewe, a continuous furnace line has been installed by **The Incandescent Heat Co. Ltd.** and their associates, **Controlled Heat and Air Ltd.**, for the forming, hardening and tempering of heavy locomotive leaf springs. The plates are conveyed through the hardening furnace on cast nickel-chromium chains. The furnace is under-fired and over-fired by fan-blast gas burners to ensure rapid and uniform heating. The leaf springs are discharged singly from the furnace, transferred to the cambering press which, when the forming operation is complete, automatically quenches the leaf at the correct hardening temperature.

The final tempering operation is per-

formed in a "Chal" chain conveyor furnace, which is equipped with a separate heater battery and recirculating fans to ensure close temperature control and uniformity throughout the working chamber.

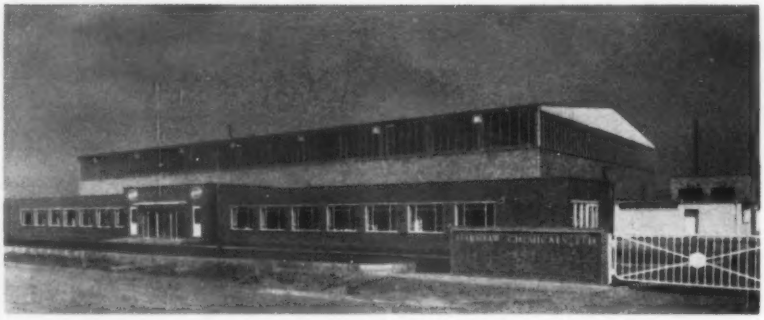
A New Daventry Factory

To serve the metal finishing industry in the Midlands, a new £100,000 factory has been established at Daventry by **Harshaw Chemicals Ltd.**, a wholly-owned subsidiary of the American organization—Harshaw Chemical Company. It was only in 1956 that the British company was established in premises in Waltham Cross, Hertfordshire, but it was soon found necessary to provide means for serving the very extensive metal finishing area in Birmingham and its surrounding cities.

The Daventry site is more than four acres in extent and has a frontage of 280 ft., being bounded at the rear by the Weedon-Leamington railway line. The building has a free floor area and is 23 ft high to the eaves. It provides modern offices along the front of the site, laboratories and a factory. Although only a single storey structure, the foundations of the building, with walling and concrete roof, have been designed to support a future upper storey.

Between the offices and the factory building there is a continuous corridor, which is lit by borrowed lights from the offices and laboratories. This has the advantage of forming a sound buffer between factory and office and makes for easy circulation between the two areas.

To mark the success of this venture, the company last week received a civic welcome from the Mayor of Daventry, Councilor L. E. Whitmee, who, on his visit to the new factory, was welcomed by Mr. Charles S. Parke, President of the American organization. During last week, also, daily receptions were held on the premises for customers and other friends.



The new Daventry premises of Harshaw Chemicals Ltd.

Stirring Motors

To their existing range of laboratory stirrers, **Griffin and George Ltd.** have added the new Griffin-Citence stirring motor. This motor is stated to be of particular use in the preparation of chemicals involving the use of liquids with high viscosity, since it has variable speed adjustment and also the ability to produce high torque at low speeds through a reduction gearbox.

Among the features incorporated in this motor is a dynamically balanced armature in sleeve bearings and integral fan cooling. A point of special interest is the combined bracket and bosshead, which permits the stirrer to be aligned in three different planes at right angles.

The stirrers are usually attached to the motor shaft by a short length of rubber or plastic tubing, but a special chuck is available as an accessory, which will accommodate stirrers of $\frac{9}{32}$ in. diameter. Three types of motor are available, each giving differing max/min. speed and torque.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week rose 116 tons to 4,335 tons, comprising London 1,168, Liverpool 1,743 and Hull 1,424 tons.

Copper stocks fell 120 tons to 15,215 tons, distributed as follows: London 450, Liverpool 13,065, Birmingham 50, Manchester 1,525, Hull 100 and Glasgow 25 tons.

Lead duty-free stocks rose 325 tons to 7,257 tons, comprising London, 6,707, Glasgow 300, Swansea 100 and Manchester 150 tons. In-bond stocks fell 41 tons to 3,452 tons, all in London.

Zinc duty-free stocks rose 305 tons to 7,864 tons, comprising London 2,428, Glasgow 31, Hull 325, Manchester 300, Liverpool 55 and Avonmouth 4,725 tons. In-bond stocks fell 50 tons to 2,985 tons, all in London.

New Factory Equipment

Automatic programme controllers are among instruments by **Honeywell Controls Limited** recently installed at the Birmingham works of Hardy Spicer Limited for heat-treatment processes on vehicle transmission components and other parts.

The programmers are circular chart controllers fitted with cams. The normal programme, carried out on six carburizing furnaces made by **British Furnaces Limited,** consists of a controlled heating cycle, a holding period for carburizing and provision for quenching the load in oil. The controllers are on panels which also contain purge and quench timers, a strip chart recorder and excess temperature safety cut-off.

Elsewhere, four B.F.L. gas generator furnaces have combustion temperatures recorded by a Honeywell instrument and will have the dew-point controlled. A new 60 ft. heat-treatment process, also by British Furnaces, has heating, carburizing and cooling zones controlled by recorder-controllers.

Contract Secured

A member of the Davy-Ashmore group, the **Power-Gas Corporation Ltd.** has been awarded the contract by the North Thames Gas Board for a 60,000,000 ft³/day continuous reforming plant. The plant is due to go into operation at Southall in July, 1963.

Aluminium in Tasmania

According to news from Melbourne, Comalco Industries Pty. Ltd. is stepping up aluminium production substantially beyond the rated capacity of its Bell Bay plant in Tasmania. Only nine months after acquisition, newly applied operating efficiencies will lift this year's output by 25 per cent to well over 14,000 tons. The smelter was originally designed to handle 12,000 tons, but was producing about 11,500 tons at the time of the take-over. Further refinements will bring another rise in production to a firm rate of 16,000 tons in 1962.

Expansion will cost more than £A7,000,000, the report said, and with the fabricating plants in Sydney it will bring Comalco's investment to £A28,000,000 in existing facilities. The ultimate target of 48,000 tons will be reached in 1965 now that the company has been offered power from the planned Derwent River station. Tasmania's ability to offer the cheapest power in Australia has been a prime factor in extending the project.

A New Film

Following the success of their first industrial film, "King's in Industry", **Geo. W. King Ltd.** have made a new film, "The Way of King's". The subject of the first film was "what King's make"; it showed a complete range under actual working conditions of mechanical handling equipment made by the firm.

The new film, with a commentary read by John Snagge, is in the nature of a sequel to the first, but is built around the theme of "how it works". It shows in detail complete handling schemes working in three diverse installations dealing with widely differing commodities: the new plating plant of Vauxhall Motors Ltd., Luton; the Peterborough factory of the Perkins Group, where 1,000 diesel engines can be turned out in a day; and Europe's largest egg packing station at Kenninghall, Norfolk, belonging to J. Sainsbury Ltd.

LIGHT METALS STATISTICS IN JAPAN (July 1961)

Classification	Production	Shipment	Stock	Export
Alumina	37,310	36,400	18,551	7,772
Super purity Al	88	188	663	0
Primary Al	13,171	12,931	2,847	0
Secondary Al	5,473	5,428	1,217	0
Wrought products (Al and its alloy)	14,846	14,864	5,257	890
Plate, sheet and strip	9,880	10,162	2,783	
Foil	917	915	352	
Rolled and extruded shape	2,621	2,553	696	584
Forgings	57	—	—	—
Electric wire	1,371	1,234	1,426	306
Powder, flake and paste	—	—	—	—
Casting	6,108	—	—	—
Sand and permanent mould	3,278	—	—	—
Die	2,830	—	—	—
Sheet products	2,702	2,421	1,664	90
Primary Mg	124	147	183	—
Secondary Mg	236	229	295	—
Mg casting	20	—	—	—
Sponge Ti	194	175	1,165	142
Super purity Al (August)	86	117	632	—
Primary Al (August)	13,280	12,724	3,403	0

This 16 mm. black-and-white film, produced by Paul Barralet Productions Ltd., has a running time of 22 min. It is available on loan, free of charge, to works, industrial organizations, technical associations and similar bodies.

International Conference

Madrid is to be the venue for the Third **International Metal Spraying Conference,** which is to be held next year from May 21-25. Full particulars of this conference are available from Instituto de la Soldadura, Serrano, 144-A, Madrid-6, Spain. In addition to the technical sessions there are to be several social occasions and interesting "sightseeing" trips, including a visit to a bull-fight.

New Zealand's Aluminium

On Monday last, New Zealand's first aluminium rolling mill, a £2,500,000 Alcan Industries Limited plant at Wiri, Auckland, was officially opened by the New Zealand Prime Minister, the Rt. Hon. K. J. Holyoake. The mill is capable of producing 5,000 tons (virtually all of New Zealand's present requirements) of aluminium sheet products a year. It comprises a complete unit with furnaces, semi-continuous casting unit, hot and cold rolling mills, and ancillary machinery.

The factory uses aluminium ingot imported from Canada, and its main products will be flat and coiled aluminium sheet, aluminium plate, various types of corrugated building sheet, circles for subsequent pressing into holloware and slugs for the production of impact-extruded items such as tubes for packaging. Before the completion of the new plant, all New Zealand's requirements of these materials had to be imported.

A New Edition

Just published is the "F.B.I. Register of British Manufacturers" for 1962, a 1,174-page book providing a comprehensive and accurate guide to a substantial cross-section of British industry. It contains lists of the products and services of over 8,000 member firms under more than 5,500 alphabetical headings.

In addition to the Classified Buyers' Guide, there are seven other sections in the Register, giving addresses of companies and firms, and valuable information about trade associations, proprietary names, trade marks, etc. The French, German and Spanish glossaries give translations of every product term used in the main buyers' guide, each being numbered for easy reference between the English headings and their translations.

The Register is published by Kelly's Directories Ltd. and Iliffe Books Ltd., at the price of 50s. post free.

Tool and Die Steels

A 16 mm. film in colour was shown to a specially selected audience in London on Wednesday by **Jessop-Saville Ltd.** With the above title, the film opens with a series of operations showing the use of tool steels in a variety of applications—hot extrusion, hot stamping, pressure die-casting, plastics injection moulding, compression moulding and cold forming, and trimming of sheet metal.

Following this introduction, the film traces the sequence of manufacture of tool and die steels—from the melting of the steel, through the many hot working and testing operations, to the inspection of the finished product. The concluding sequence shows how blocks of steel are transformed by the toolmaker into intricate dies and moulds.

Running time of the film is 25 minutes and copies are available on free loan, but should be booked in advance for showing on a specific date.

Aluminium Building Sheets

An eight-page information booklet dealing with aluminium building sheets has just been issued by **James Booth Aluminium Ltd.** Produced in accordance with the international paper classification (A4 and SfB) it contains full data on three standard profiles of corrugated and troughed aluminium building sheet: 3 in. corrugated, Mansard and Trough (type "A"). Full physical descriptions are given, together with design load tables and comprehensive installation notes.

A further section of the booklet deals with ancillary preformed flashings, and an approximate supply price list for the three profiles is also given. A number of diagrams and illustrations are included.

A New Exhibition

Planned to be held in London during February of 1963 is the first International Industrial Lubrication Exhibition, which will have a special interest for every manufacturing company using plant, machinery and equipment.

A Grant for Research

In response to a general appeal by Sheffield University for funds, **Viners of Sheffield** have donated £1,000 for non-ferrous metallurgical research. The grant is being given over a period of five years at the rate of £200 per year.

Viners feel that very little research has been carried out in this particular field, especially with regard to nickel silver. As they are one of the largest producers of non-ferrous metal tableware in this country, it is appropriate that the donation be used for this specific branch of the University's research studies.

An Appointment

News from **Stanley Works (G.B.) Ltd.** is that they have appointed Mr. Ronald Shelton to head a new department responsible for the design and development of new products.

An Acquisition

It is reported from New York that Standard Beryllium Corporation has acquired 84 per cent of the issued and outstanding stock of Lajo Mines Limited, producers and concentrators of silver with lead and zinc as by-products, according to Mr. Philip Brandon, President.

Included are Lajos mines, other properties and a mill located near Kaslo, in British Columbia. Mr. Brandon said this was Standard's first major expansion involving a mineral other than beryllium.

Safety and Health

At a time when the Chief Inspector of Factories report, just published, shows last year's total industrial accidents at 190,266, more than the previous year, and 675 ending in death, a new edition of "Safety and Health in Industry" is being made available without cost.

The seven major sections of this 150-page publication, with over a hundred photographs, diagrams, charts and other illustrations, cover (a) machine guarding, (b) industrial health engineering, (c) personal protection, (d) material handling, (e) housekeeping and maintenance, (f) fire protection, (g) general section.

This book has been produced primarily as an easy-to-read guide on basic rules on safety, etc., in industry and is particularly

Forthcoming Meetings

November 20—North-East Metallurgical Society. Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough. "Recent Advances in the Foundry." A. T. Andrews. 7.30 p.m.

November 20—Institute of Metal Finishing. London Branch. Northampton College of Technology, St. John Street, London, E.C.1. "Detection and Removal of Hydrogen Absorbed During Chemical and Electrochemical Processing." L. E. Probert and J. Rollinson. 6.15 p.m.

November 21—Institute of Metal Finishing. South-West Branch. Royal Hotel, Bristol. "Solutions for Hard Chromium Plating." D. N. Layton. 7.30 p.m.

November 21—Institution of Production Engineers. Manchester Senior and Graduate Section. Reynolds Hall, Manchester College of Science and Technology, Sackville Street, Manchester. "Application of Metal Deposition." W. E. Ballard. 7.15 p.m.

November 22 — British Interplanetary Society. Lecture Theatre, Royal Aeronautical Society, Hamilton Place, London, W.1. One-day Symposium on "Materials in Space Technology." 9.30 a.m.

November 22—Institution of Production Engineers. London-Brighton Group. A.P.V. Company Ltd., Crawley. "A Review of New Techniques in the Manipulation of Metals." G. G. Dewsnap. 7 p.m.

November 22—Manchester Metallurgical Society. Manchester Literary and Philosophical Society, George Street, Manchester. "Metallurgy of the Rarer Metals." Dr. J. C. Chaston. 6.30 p.m.

November 23—Birmingham Metallurgical Society. College of Technology, Gosta Green, Birmingham. "The Cold Extrusion of Steel." R. W. A. Wright. 6.30 p.m.

November 23 — Institute of Metals. Sheffield Local Section. Applied Science Building, Sheffield University, St. George's Square, Sheffield. "Inclusions in Metals." B. P. Barnsley, T. R. Allmand and Dr. D. A. Melford. 2 p.m.

November 23 — Southampton Metallurgical Society. Southampton University. "Electro-Plating Processes: Effect on Fatigue Strength and Embrittlement of the Substrata." C. Williams. 7.15 p.m.

November 23 — Institution of Plant Engineers. Merseyside and N. Wales Branch. The Blossoms, Chester. "Refractories for Boilers and Furnaces: Construction and Maintenance." M. Ash, L. I. Ceram and N. W. Hinchcliffe. 7.15 p.m.

useful to the foreman, works manager, or executive, anxious to prevent the loss to industry of some 20,000,000 man-days annually. Copies of the book may be obtained from the Industrial Health and Safety Centre, 97 Horseferry Road, Westminster, London, S.W.1.

Yugoslav Lead and Zinc Deposits

News from Belgrade states that the opening up of the lead and zinc ore deposits in the Osogovska Planina range in Eastern Yugoslavia (Macedonia), close to the Bulgarian frontier, has now been approved by the authorities. The deposits have been known for some time, but intensive prospecting has started only comparatively recently.

It is expected that during the initial stage of exploitation the deposit will yield a total of 220,000 tons of lead, zinc and pyrites ores annually. This total will eventually rise to 300,000 tons, and Yugoslav quarters eventually expect an annual zinc and lead concentrate output of 250,000 tons.

Telephone Number

Through the reorganization of the Gresham Lion Group of Companies, the telephone number of the group was changed; but not that for the Small Transformers Division of **Gresham Transformers Ltd.**, which remains as Feltham 6661.

Parliamentary News

On Tuesday next, November 21, Mr. Leonard Cleaver (Con., Birmingham, Yardley), is to ask the President of the Board of Trade in the Commons whether he will re-allocate the items included under the different headings in the Census of Production in order to give more useful information to the metal working industries.

News from Birmingham

Trade conditions in the Midland area have changed little in the past week. There is, however, some slight improvement in the motor trade because of recent export orders by the principal firms. It is hoped that this will be reflected in larger orders for raw materials at a later date, but motor manufacturers are not getting much encouragement from the state of the home market. Building activity is maintained and there is a fair market for non-ferrous castings and pressings. The machine tool manufacturers have sufficient contracts to secure good employment to the end of the year and into the first quarter of 1962.

Indication of the confidence of a firm of local steel strip makers is shown by the announcement that it has increased its output of wide strip by 33⅓ per cent. Most of the extra production will be for export. The market continues strong for all kinds of structural steel. Re-rollers have spare capacity for the production of sections and bars. Ironfoundries also could do with more work. There are ample supplies of pig iron available despite the fact that the number of furnaces active in the Midlands is lower than it was at the beginning of the year.

A Cable Contract

Against severe international competition, the **British Insulated Callender's Cables** group of companies have secured a £330,000 contract from the Central Electricity Board of the Federation of Malaya for the supply and installation of some 60 miles of cables — power, control and telephone — for the Cameron Highlands hydroelectric scheme. This is said to be one of the largest contracts of its kind ever to be awarded by the C.E.B. of Malaya.

Italian Copper Imports

Statistics issued in Rome show that Italian imports of crude copper during the first seven months of this year amounted to 8,819·8 metric tons, valued at 3,285,710,000 lire, of which 1,475·4 metric tons, valued at 544,180,000 lire were temporary imports. The principal suppliers were Rhodesia and Nyasaland with 3,191.4 tons, South Africa with 1,629·7 tons, and the United States with 3,086·0 tons.

Imports of refined copper in slabs, plates and ingots, etc., during the first seven months of the year amounted to 117,389·6 metric tons valued at 44,542,503,000 lire, of which 9,832·0 tons, valued at 3,778,446,000 lire were imported temporarily. The main suppliers of refined during the period were: France, with 2,802·0 tons; Belgium/Luxembourg, with 2,932·5 tons; the United Kingdom, with 9,628·3 tons; Congo Republic, with 19,313·0 tons; Rhodesia and Nyasaland, with 19,321·0 tons; South Africa, with 4,068·8 tons; the United States with 40,601·9 tons; Canada, with 3,435·4 tons; and Chile, with 11,147·7 tons.

Advance Tin Statistics

The International Tin Council announces the following advance statistics on tin. Mine production of tin-in-concentrates in the Federation of Malaya remained almost unchanged in September at 4,580 tons, against 4,577 tons in August. Output in Thailand dropped from 1,241 tons in August to 1,025 tons in September. Bolivian production fell from 1,800 tons in July to 1,594 tons in August. Production in the Federation of Nigeria rose slightly from 605 tons in July to 654 tons in August and to 768 tons in September. Smelter production of tin metal in the United Kingdom rose from 1,842 tons in August to 2,282 tons in September. Belgian production declined slightly from 605 tons in August to 538 tons in September.

Exports of tin-in-concentrates from Bolivia rose from 945 tons in July to 1,338 tons in August. Exports from Thailand fell from 1,483 tons in August to 939 tons in September.

Imports of tin-in-concentrates into Malaya and Singapore fell sharply to 1,323 tons — provisional — in September from 2,210 tons in August. Imports into the United Kingdom fell from 2,220 tons in August to 1,099 tons in September. Imports into the United States of America declined from 490 tons in July to 375 tons in August.

Exports of tin metal from Malaya and Singapore rose from 6,817 tons in August to 7,436 tons in September, but in October they fell sharply to 4,663 tons—provisional. Exports from the United Kingdom rose slightly from 456 tons in August to 616 tons in September. Exports from the Netherlands increased to 659 tons in September, compared with 347 tons in August. Imports of tin metal into the United States fell from 4,904 tons in July to 4,034 tons in August. Imports into Federal Germany again fell sharply in August to 1,079 tons against 1,983 tons in July.

Stocks of tin-in-concentrates in Bolivia rose slightly from 1,743 tons at end-July to 1,811 tons at end-August. Stocks at smelters in the United Kingdom dropped sharply to 785 tons at the end of September from 1,505 tons at the end of August. Consumption of primary tin metal in the United States rose from 3,920 tons in July to 4,570 tons in August. Consumption in the United Kingdom during September amounted to 1,830 tons—provisional—compared with 1,428 tons in August.

The Building Exhibition

THERE are a number of interesting exhibits at the **Building Exhibition,** which opened on Tuesday last at Olympia, London, and will remain open until November 29 next. Among these exhibits are the following:—

The ever-increasing uses of aluminium and its alloys in building are being demonstrated on Stand F.203 by **Alcan Industries Limited,** where prominence is being given to Noral building sheets with a durable painted finish in a variety of colours. A newly developed Noral wide-pitch industrial sheet is also being shown, as well as a Noral deep curved trough industrial sheet, a 20 ft. length of which is incorporated to represent its use for barrel-vault roofing.

By incorporating copper and several of its alloys in both the design and construction of their stand, No. 449-450, the **Copper Development Association** is presenting with considerable effect the undoubted aesthetic appeal of these metals. This year, the **Zinc Development Association** and the **Lead Development Association** are participating on adjoining stands, H.255-256, and an impressive two-tier exhibit has been designed for both. The value of these metals in building are adequately described and their many uses are detailed.

One of the major exhibits on the stand of **James Booth Aluminium Limited** (Stand 1013-1014) is their new interlocking facing system. A complete system of decorative ribbed facing for building surfaces is provided by nine extruded sections. Some of its applications are wall lining, canopy soffits, column cladding, or as infill panelling in curtain walling.

The **Hunter Douglas Group** of companies, on Stand B.132, is introducing a range of aluminium building components based on one standard colourfully stove-enamelled panel. On Stand D.172-4, **Imperial Chemical Industries Limited** are showing a wide range of their products from various divisions, including copper sheet, Impalco aluminium, etc.

The exhibit of **The British Aluminium Company Limited,** on Stand E.196-197, follows the main theme of the Exhibition with a comprehensive display of literature relating to the new British Aluminium Building Service for architects. On Stand F.210, **Yorkshire Imperial Metals Limited** are displaying, among other items, their Kite marked copper building service tubes, etc.

The use of "Alminal" aluminium alloys in many aspects of the building trade is shown on Stand 1027-8 with the aid of photographs and lengths of the actual extruded sections employed by **Southern Forge Limited.**

Metal Market News

ADVANCE figures published by the British Bureau of Non-Ferrous Metal Statistics show that consumption in September made a notable advance on August, which is, of course, the outstanding holiday month of the year. In the case of copper, overall consumption totalled 60,028 tons, compared with 40,920 tons in August. Stocks of copper were reduced by about 5,000 tons for the figure of 147,948 tons on hand at September 30, compared with 152,898 tons a month earlier. In tin, consumption improved from 1,446 tons in August to 1,849 tons in September, while stocks fell from 8,350 tons to 7,662 tons at the end of September. Lead showed an advance of 6,543 tons in consumption to 31,359 tons in September, while stocks rose from 64,849 tons at August 31 to 65,391 tons at the end of September. Copper usage certainly scored a notable advance in September, but August was a long way below the average for the year. The position in copper seems to be that whereas the electrical side of the industry is keeping up very well, there is a decline in demand in other directions, particularly in regard to brass. The zinc figures for September show an increase of more than 7,000 tons in consumption, the comparative figures being 21,501 tons and 28,778 tons. Stocks at the end of September were 69,491 tons against 70,637 tons at August 31.

The copper market last week opened on a steady note following news of a reduction of 225 tons in L.M.E. stocks to 15,335 tons. With every prospect of a strike coming in Chile at the end of the week, the quotation advanced to £232 cash on Thursday, but Friday brought a sharp reversal in the trend when news came through that a decision to strike had been postponed for five days. Both at midday and in the afternoon, values gave way and the week ended with cash and three months at £227 10s. 0d. The turnover was rather more than 11,000 tons and, on balance, cash lost £2 10s. 0d. and three months £2 15s. 0d. As we write, market opinion feels that a strike is now unlikely and that, therefore, unless influential buying supervenes, a recovery is rather unlikely just now. Certainly, the consumers do not appear to be alarmed, for buying has been on a very modest scale. Scrap is reported to be plentiful and prices have eased. In the States, metal business is going fairly well, but it would probably be wrong to say that there is a prospect of much expansion.

Tin gave a pretty good account of itself, and the market was cheered by the news that the G.S.A. had turned down all bids on account of their not being high enough. The peak of the week was £974 cash and £975 three months, but at the close the prices were £972 and £973. On a turnover of 1,880 tons, cash lost £2 and three months gained £4. Stocks fell by 264 tons to 4,219 tons. Both lead and zinc made a poor showing. Stocks of lead dropped by 759 tons to 10,425 tons, but the market was depressed on news that the Mount Isa strike would be settled. Apart from that, demand from consumers was none too good and, finally, on a turnover of 7,000 tons cash lost £1 17s. 6d. at £59 17s. 6d., while three months closed 30s. down at £61. Lead is now below £60, but may go lower. Stocks of zinc decreased by 193 tons to 10,594 tons, but sentiment was adversely affected by a release of 880 tons of high grade by the Board of Trade. Finally, after a turnover of 8,200 tons, cash closed £2 5s. 0d. down at £68 15s. 0d., and three months £2 2s. 6d. lower at £69 15s. 0d.

New York

Copper futures were easier at the week-end, on liquidation, but held steady toward the close. Dealings were active, and selling reflected the postponement of the Chilean strike. Physical copper was softer in the export market and the dealer domestic sector. Customs smelters and producers indicated continued modest enquiry for December copper, but they termed it normal for this time of year. Scrap copper was $\frac{1}{4}$ cent lower, custom smelters bidding $24\frac{1}{4}$ cents/lb. for No. 2 scrap. Tin was quiet and steady. Prices were unchanged. Lead and zinc were quiet.

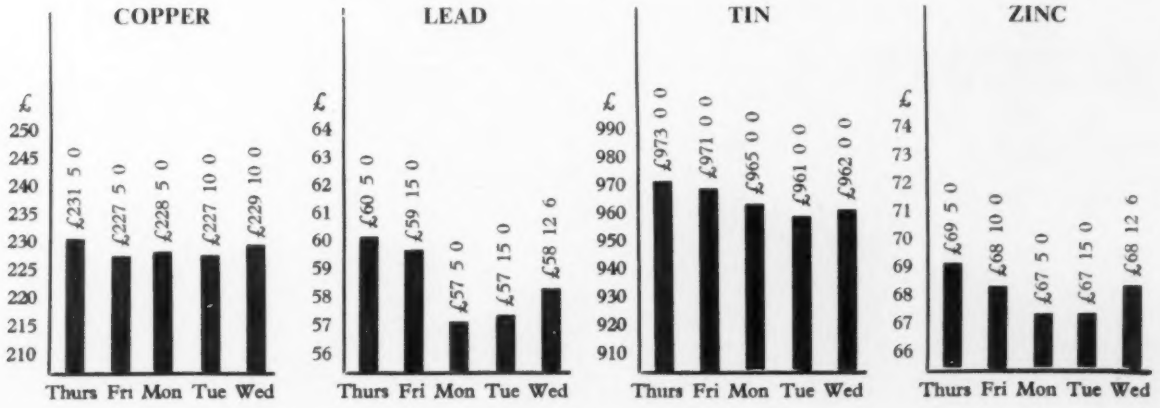
The General Services Administration announced last week the sale of 150 long tons of Grade B tin to Metal Traders of New York at $1.2007 per lb. A G.S.A. spokesman said that was the only offering accepted when bids were opened to buy 20,200 tons of the tin, a Longhorn Grade, which had been taken over by the G.S.A. when the formerly Government-owned Texas City tin smelter was sold to private interests. The G.S.A. offering was 850 tons of Grade A tin and 150 tons of Grade B. The G.S.A. spokesman, expressing disappointment in the sales, said the prices offered were "too low".

Paris

The Paris scrap market developed a steadier trend in the week ended November 9. This applies especially to copper products which benefited from improved foreign advices. Demand revived slightly for copper, bronze and brass, and sellers raised their bids. Trading was quiet elsewhere, but a steadier undertone was reported, as selling pressure decreased.

London Metal Exchange

Thursday 9 November to Wednesday 15 November 1961



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NON-FERROUS

PRIMARY METALS

All prices quoted are those available at 2 p.m. 15/11/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	237	10	0
Antimony Metal 99%	„	230	0	0
Antimony Oxide				
Commercial	„	194	10	0
Antimony White Oxide	„	212	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	6
Calcium	„	2	0	0
Cerium 99%	„	18	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite per unit			8	10	0
Copper H.C. Electro	ton	229	10	0
Fire Refined 99·70%	„	228	0	0
Fire Refined 99·50%	„	227	0	0

		£	s.	d.
Copper Sulphate	ton	78	0	0
Germanium	grm.		—	
Gold	oz.	12	10	1¼
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	58	12	6
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		5	6
Alloy Ingot. AZ91X		1	11½-2	1¼
Manganese Metal	ton	280	0	0
Mercury	flask	59	0	0
Molybdenum	lb.	1	15	0
Nickel	ton	660	0	0
F. Shot	lb.		5	11
F. Ingot	„		5	11
Osmium	oz.	20	0	0
Osmiridium	„		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	123	0	0
Silver Spot Bars	oz.		6	8
Tellurium Sticks	lb.	2	0	0
Tin	ton	962	0	0
*Zinc				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	69	3	9
Dust 95/97%	„	112	0	0
Dust 98/99%	„	118	0	0
Granulated 99+%	„	94	3	9
Granulated 99·99+%	„	105	11	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

All prices quoted are those available at 2 p.m. 15/11/61

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5 ton		nom.	
B.S. 1490 L.M.6 „		„	
B.S. 1490 L.M.7 „		„	
B.S. 1490 L.M.8 „		„	
B.S. 1490 L.M.9 „		„	
B.S. 1490 L.M.10 „		„	
B.S. 1490 L.M.11 „		„	
B.S. 1490 L.M.12 „		„	
B.S. 1490 L.M.13 „		„	
B.S. 1490 L.M.14 „		„	
B.S. 1490 L.M.15 „		„	
B.S. 1490 L.M.16 „		„	
B.S. 1490 L.M.18 „		„	
B.S. 1490 L.M.22 „		„	
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 ton	144	0	0
B.S. 1490 L.M.2 „	145	0	0
B.S. 1490 L.M.4 „	154	0	0
B.S. 1490 L.M.6 „	170	0	0
***Aluminium Bronze**			
BSS 1400 AB.1 ton	237	0	0
BSS 1400 AB.2 „	245	0	0

		£	s.	d.
***Brass**				
BSS 1400-B3 SCB2	ton	175	0	0
BSS 249	„	172	0	0
***Gunmetal**				
B.S. 1400: LG2 d/d	„	208	0	0
B.S. 1400: LG3 d/d	„	219	0	0
B.S. 1400: GI 1½ Pb d/d	„	279	0	0
B.S. 1400: GI ½ Pb d/d	„	293	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	192	0	0
BSS 1400 HTB2	„	211	0	0
BSS 1400 HTB3	„	227	0	0
Nickel Silver				
Casting Quality 12%	„	255	0	0
„ „ 16%	„	265	0	0
„ „ 18%	„	310	0	0
***Phosphor Bronze**				
B.S.1400P.B.1.(A.I.D. released)	„	312	0	0
B.S. 1400 L.P.B.1	„	233	0	0

**Average prices for the last week-end.*

Phosphor Copper	£	s.	d.
10% ton	251	0	0
15% „	254	0	0
Phosphor Tin			
5% „	1046	0	0
Silicon Bronze			
BSS 1400-SB1 „	270	0	0
Solder, soft, BSS 219			
Grade C Tinmans „	426	0	0
Grade D Plumbers „	336	5	0
Grade M „	472	0	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „		—	
Zinc Alloys			
BSS 1004 Alloy A ton	99	1	3
BSS 1004 Alloy B „	103	1	3
Sodium-Zinc lb.		2	5½

SCRAP METALS

Merchants' average buying prices delivered, per ton, 14/11/61

Aluminium	£
New Cuttings	134
Old Rolled	98
Segregated Turnings	72
Brass	
Cuttings	154
Rod Ends	141
Heavy Yellow	132
Light	127
Rolled	142
Collected Scrap	129
Turnings	133

Copper	£
Wire	205
Firebox, cut up	203
Heavy	197
Light	192
Cuttings	208
Turnings	194
Braziery	162
Gunmetal	£
Gear Wheels	196
Admiralty	196
Commercial	175
Turnings	170

Lead	£
Scrap	49
Nickel	
Cuttings	—
Anodes	590
Phosphor Bronze	
Scrap	175
Turnings	170
Zinc	
Remelted	62
Cuttings	51
Old Zinc	32

METAL PRICES

SEMI-FABRICATED PRODUCTS

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products

Aluminium			£	s.	d.
Sheet	10	S.W.G. lb.		2	10½
Sheet	18	S.W.G. ,,		3	0½
Sheet	24	S.W.G. ,,		3	3½
Strip	10	S.W.G. ,,		2	10½
Strip	18	S.W.G. ,,		2	11½
Strip	24	S.W.G. ,,		3	1
Circles	22	S.W.G. ,,		3	4½
Circles	18	S.W.G. ,,		3	3½
Circles	12	S.W.G. ,,		3	2½
Plate as rolled		,,		2	10
Sections		,,		3	4
Wire 10 S.W.G.		,,		3	1½
Tubes 1 in. o.d. 16 S.W.G.		,,		4	4

Aluminium Alloys			£	s.	d.
BS 1470. HS19W.					
Sheet	10	S.W.G. ,,		3	3
Sheet	18	S.W.G. ,,		3	5½
Sheet	24	S.W.G. ,,		4	1
Strip	10	S.W.G. ,,		3	3
Strip	18	S.W.G. ,,		3	4½
Strip	24	S.W.G. ,,		4	0½
BS1477. HP30M.					
Plate as rolled		,,		3	1
BS1470. HC15WP.					
Sheet	10	S.W.G. ,,		4	3
Sheet	18	S.W.G. ,,		4	8½
Sheet	24	S.W.G. ,,		5	8½
Strip	10	S.W.G. ,,		4	4
Strip	18	S.W.G. ,,		4	8½
Strip	24	S.W.G. ,,		5	4½

Aluminium Alloys—cont.		£	s.	d.
BS1477. HPC15WP. Plate heat treated	lb.		3	10½
BS1475. HG19W. Wire 10 S.W.G.	,,		4	2
BS1471. HT19WP. Tubes 1 in. o.d. 16 S.W.G.	,,		5	5
BS1476. HE19WP. Sections	,,		3	4
Split tube				
19 S.W.G. (⅛")	,,		4	2
20 S.W.G. (⅜")	,,		3	11
21 S.W.G. (⅜")	,,		4	1
22 S.W.G. (¼")	,,		4	11
Welded tube 14 to 20 S.W.G. (sizes ½" to 1½")	,,	3/5½ to 5/5		

Brass		£	s.	d.
Tubes	lb.		1	9¾
Brazed Tubes	,,		3	1¾
Drawn Strip Sections	,,		3	1¾
Sheet	ton	195	10	0
Strip	,,	195	10	0
Extruded Bar	lb.		1	11¾
Condenser Plate (Yellow Metal)	ton	184	0	0
Condenser Plate (Naval Brass)	,,	198	0	0
Wire	lb.		2	8½

Beryllium Copper		£	s.	d.
Strip	lb.	1	4	11
Rod	,,	1	1	6
Wire	,,	1	4	9
Copper				
Tubes	lb.		2	3⅛
Sheet	ton	262	10	0
Strip	,,	262	10	0
H.C. Wire	,,	280	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	8¼
Lead				
Pipes (London)	ton	103	5	0
Sheet (London)	,,	101	0	0
Tellurium Lead	,,	£6 extra		
Nickel Silver				
Sheet and Strip 10%	lb.		3	11¾
Wire 10%	,,		4	4¾
Phosphor Bronze				
Wire	,,		4	2
Titanium (1,000 lb. lots)				
Billet 4½" to 18" dia.	lb.	47/-		48/-
Rod ¼" to 4" dia.	,,	85/-		53/-
Wire ·036"·232" dia.	,,	159/-		99/-
Strip ·001" to ·048"	,,	350/-		68/-
Sheet 8'×2'. 20 gauge	,,	73/-		
Tube, representative average gauge	,,	198/-		
Extrusions	,,	90/-		
Zinc				
Sheet	ton	105	10	0
Strip	,,	nom.		

FOREIGN QUOTATIONS

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

Belgium	fr/kg	£/ton
Copper: electrolytic	31.75	232 1
Tin	135.15	987 16

Canada	c/lb	£/ton
Aluminium	24.00	194 8
Copper: electrolytic	30.00	243 0
Lead	10.50	81 0
Nickel	70.00	567 0
Zinc: Prime western	12.00	97 4
High grade 99.95	12.60	102 1
High grade 99.99	13.00	105 6

France	fr/kg	£/ton
Aluminium	2.43	179 11
Antimony 99·0	2.80	206 18
Cadmium	16.75	1,247 16
Copper: electrolytic	3.21	237 4
Lead	.90	66 10
Nickel	9.00	665 2
Tin	13.84	1,022 15
Zinc: Thermic	1.07	79 1
Zinc: electrolytic	1.15	85 0
Scrap		
Copper: electrolytic	2.85	210 12
Heavy copper	2.85	210 12
No. 1 copper wire	2.78	205 8
Brass rod ends	2.20	162 11
Zinc castings	.85	62 16
Lead	.83	61 6
Aluminium	1.80	133 0

Italy	lire/kg	£/ton
Aluminium	370	216 1
Antimony 99·0	470	274 9
Copper: wire bars 99·9	445	259 17
Lead	161	94 4
Nickel	1,300	805 14
Tin	1,840	1,074 11
Zinc: electrolytic	170	99 3
Scrap		
Aluminium soft sheet clippings (new)	290	169 7
Lead, soft, first quality	133	77 13
Lead, battery plates	75	43 16
Copper, first grade	370	216 1
Bronze, commercial gunmetal	420	245 7
Brass: heavy	270	157 13
Brass: light	255	148 18
Brass, bar turnings	265	154 15
Old zinc	95	55 9

Switzerland	fr/kg	£/ton
Aluminium	2.50	210 5
Copper: electrolytic	2.88	242 4
Lead	.80	67 5
Nickel	7.68	645 17
Tin	11.68	982 5
Zinc: High grade 99.99	.98	82 8

Japan	Yen per metric ton
Scrap	
Copper: electrolytic	268,000
Copper wire No. 1	236,000
Copper wire No. 2	225,000
Heavy copper	231,000
Light copper	210,000
Brass, new cuttings	175,000
Red brass scrap	215,000

West Germany *Scrap*	D-marks per 100 kilos	£/ton
Used copper wire	215	195 17
Heavy copper	212	193 2
Light copper	185	168 10
Heavy brass	145	132 1
Light brass	110	100 5
Soft lead	50	45 11
Zinc	48	43 14
Used aluminium unsorted	90	82 0

United States	c/lb	£/ton
Aluminium	24.00	191
Antimony 99·0	32.50	259 0
Cadmium	160.00	1,275 4
Copper: electrolytic	31.00	247 10
Lead	10.50	83 13
Nickel	81.25	647 11
Tin	123.62	985 5
Zinc: electrolytic	12.50	99 12

THE STOCK EXCHANGE

A Return Of Optimism

ISSUED CAPITAL	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 13 NOVEMBER +RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation	29/3 +3d.	11	9	7 10 6	33/9	26/3	35/–	26/6
400,000	2/–	Anti-Attrition Metal	1/3	NIL	4	NIL	1/3½	0/9	1/6	0/9
43,133,663	Stk. (£1)	Associated Electrical Industries	34/– +3/3	15	15	8 16 6	54/10½	28/3	67/3	38/3
3,895,963	1	Birfield	61/6 —6d.	10	15‡	3 5 0	78/9	45/–	51/3	29/–
4,795,000	1	Birmid Industries	68/9xd +2/1½	20	20	5 16 3	103/–	68/3	74/9	56/–
8,445,516	Stk. (10/–)	Birmingham Small Arms	22/3xd +1/–	11½	11½K	5 1 6	36/10½	19/3	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	13/– +6d.	5	5	7 13 9	14/6	12/3	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/6 +1/–	6	6	7 5 6	17/6	15/4½	20/–	17/1½
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6%	16/3	6	6	7 7 9	18/–	15/3	21/1½	17/7½
21,737,634	Stk. (£1)	British Insulated Callender's Cables	58/3 +1/–	13½	13½	4 12 9	62/3	49/–	61/4½	47/–
30,683,348	5/–	British Oxygen Co. Ltd., Ord.	15/6 —6d.	16D	16	3 8 9	28/4½	14/9	35/–	19/10½
1,200 000	Stk. (5/–)	Canning (W.) & Co.	14/6	15½	25 + *2½C‡	5 13 0	20/9	13/7½	19/9	13/7½
60,484	1/–	Carr (Chas.)	10½d. —1½d.	NIL	12½	—	1/7½	10½d.	2/3	1/–
550 000	1	Clifford (Chas.) Ltd.	27/9 —1/3	12	10	8 13 0	31/–	26/–	35/–	28/9
45,000	1	Ditto Cum. Pref. 6%	15/–	6	6	8 0 0	15/3	15/–	16/–	15/10½
1,166,000	Stk. (2/–)	Clifford Components V	8/6 +6d.	25*2½C	25*2½C	5 17 9	10/1½	7/3	11/9	6/10½
300,000	2/–	Coley Metals	2/9 +1½d.	15	15	10 18 3	4/5½	2/7½	5/–	3/4½
10,185,696	1	Cons. Zinc Corn.†	51/– —9/–	20O	15	7 16 9P	81/6	51/–	80/9	59/6
5,399,056	5/–	Davy-Ashmore	30/–	27½	22½	4 11 3	44/6	27/–	147/3	99/6
8,995,011	5/–	Delta Metal	20/6	20	17½	4 17 6	27/7½	19/–	29/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	36/3 —1/9	15	15	8 5 6	52/3	36/–	56/9	45/–
1,155,000	1	Evered & Co.	42/– —9d.	10	10‰B	4 15 3	45/9	42/–	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	29/– +2/9	10	10	6 18 0	39/6	24/3	47/9	29/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	48/9	25	20	5 2 6	65/–	42/9	52/6	40/–
937,500	5/–	Glacier Metal Co. Ltd.	18/– +1/3	15	13	4 6 3	21/1½	13/9	16/1½	11/1½
2,750,000	5/–	Glynwed Tubes	22/9 +3d.	22½	25¶	4 19 0	30/3	22/6	27/6	17/–
7,228,065	10/–	Goodlass Wall & Lead Industries	30/9	15	19L	4 17 6	44/9	28/–	41/9	33/–
696,780	10/–	Greenwood & Batley	14/6	15	30‡	10 7 0	29/6	14/3	33/6	29/1½
792 000	5/–	Harrison (B'ham) Ord.	8/9	*10	*20‡	5 4 3	14/6	8/6	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	18/3	7	7	7 13 6	20/4½	18/–	23/6	22/–
1,612,750	5/–	Heenan Group	13/-xd —1½d.	13	11½K	5 0 0	17/1½	10/6	13/–	9/10½
266,608,683	Stk. (£1)	Imperial Chemical Industries	63/6 +1/9	13½	11½	4 5 0	81/6	56/3	76/6	54/–
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	15/–	5	5	6 13 3	16/–	13/10½	18/–	15/4½
29,196,118	**	International Nickel	144 +2	$1.60	$1.50	1 17 0	160	104	105	84½
6.000,000	1	Johnson, Matthey & Co.	75/– +1/–	15	12	4 0 0	75/3	57/6	67/6	44/9
600,000	10/–	Keith, Blackman	17/– —6d.	17½	17½E	10 6 0	21/6	16/6	32/6	17/6
320,000	4/–	London Aluminium	10/– 1/3	N	13	—	15/–	8/6	12/6	7/10½
2.667,542	1	McKechnie Bros. A Ord.	31/-xd —1/–	11½K	17½	7 9 3	53/3	31/3	69/3	55/–
1,108,268	5/–	Manganese Bronze & Brass	9/– —9d.	20½	20½	11 11 6	18/6	8/10½	18/6	13/4½
50,628	6/–	Ditto (7½% N.C. Pref.)	5/–	7½	7½	9 0 0	6/–	5/–	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	85/– +4/6	12	12M	2 16 6	100/9	63/3	84/3	61/–
415,760	Stk. (2/–)	Metal Traders	7/3 —3d.	25	50H	6 18 0	8/9	6/9	10/9	7/1½
240,000	1	Mint (The) Birmingham	35/– +9d.	15G	12½	5 14 3	35/9	24/–	39/–	33/6
80,000	5	Ditto Pref. 6%	71/–	6	6	8 9 0	77/6	70/–	80/–	75/–
274,152	1/–	Minworth Metals	4/9	30	30S	6 6 3	6/3	4/6½	5/2½	3/10½
5,187,938	Stk. (£1)	Morgan Crucible A	58/9	14	13	4 15 3	71/3	53/4½	63/–	47/6
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref.	15/6	5½	5½	7 2 0	17/–	13/10½	18/9	15/9
3,850,000	Stk. (£1)	Murex	39/6 +6d.	13	22½J	6 11 9	52/–	36/9	45/–	35/3
585,000	5/–	Ratcliffs (Great Bridge) Ord	15/6xd	10	10R	3 4 6	16/6	15/6	17/–	14/9
1,064,880	10/–	Sanderson Kayser	35/6 +1/6	17½	35†	4 19 6	41/3	29/–	40/3	27/7½
3,400,500	Stk. (5/–)	Serck	13/– —1½d.	12½	12½	4 16 3	19/3	12/10½	25/6	15/3
212,384	5/–	Stedall & Co.	7/6	15	15	10 0 0	10/3	7/3	10/3	6/3
8,035.372	Stk. (£1)	Stone-Platt Industries	40/– —1/6	16O	15	8 0 0W	67/–	39/3	64/4½	52/3
2,928 963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/– —6d.	5½	5½	7 6 9	18/–	13/6	18/7½	15/3
35,344,881	Stk. (£1)	Tube Investments Ord.	67/– +3/3	14	18½	4 3 6	85/6	54/–	140/3	63/10½
41,000,000	Stk. (£1)	Vickers	26/– —6d.	10	10	7 13 9	38/3	25/9	39/7½	27/1½
750,000	Stk. (£1)	Ditto Pref. 5%	13/6 +6d.	5	5	7 8 3	15/–	12/4½	17/6	13/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/–	*5	*5	7 8 9A	21/1½	18/–	24/6	20/1½
4,594,418	1	Ward (Thos. W.) Ord	65/6 —6d.	13½	13½	4 4 0	84/6	64/6	94/–	63/–
7,109,424	Stk. (£1)	Westinghouse Brake	26/–	11	10	8 9 0	46/3	24/6	60/6	37/6
323,773	2/–	Wolverhampton Die-Casting	7/3 —6d.	35	30	9 13 0	13/4½	7/–	13/10½	8/1½
591,000	5/–	Wolverhampton Metal	20/6 +6d.	32½	32½	7 19 6	30/–	19/6	39/9	23/9
156,930	2/6	Wright, Bindley & Gell	4/3	15	20‡	8 16 6	4/9	3/7½	4/6	2/10½
124,140	1	Ditto Cum. Pref. 6%	12/9	6	6	9 8 3	13/7½	12/6½	15/–	13/6
150.000	1/–	Zinc Alloy Rust Proof	4/3 —1½d.	40	30	9 8 3	5/6	4/–	5/4½	4/–

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡and 100% capitalized issue. e The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. d and 6⅔% from Capital Profits. B and 50% capitalized issue. G and 50% capitalized issue. F and special 5% tax free dividend and 50% capitalized issue. ¶and 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. J and 75% capitalized issue. Q also 1/– special tax free dividend and 50% capitalized issue. T Per £1 unit. K 50% capitalized Issue allowed for. S and 50% capitalized issue. V incorporating Clifford Covering. H including bonus 12½%. N current interim dividend passed. O current interim reduced. P calc. at 20%. W calc. at 16%.

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★ ***CONTINUOUS PRODUCTIVITY***

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A Reverbale in a Coventry foundry melted 5,227.5 lb. of metal in 8 hours 10 minutes using 42.5 gallons of fuel oil. **Fuel consumed per hour of operation — 5.2 gallons. Fuel consumed per lb. of metal — 0·008 gallons**

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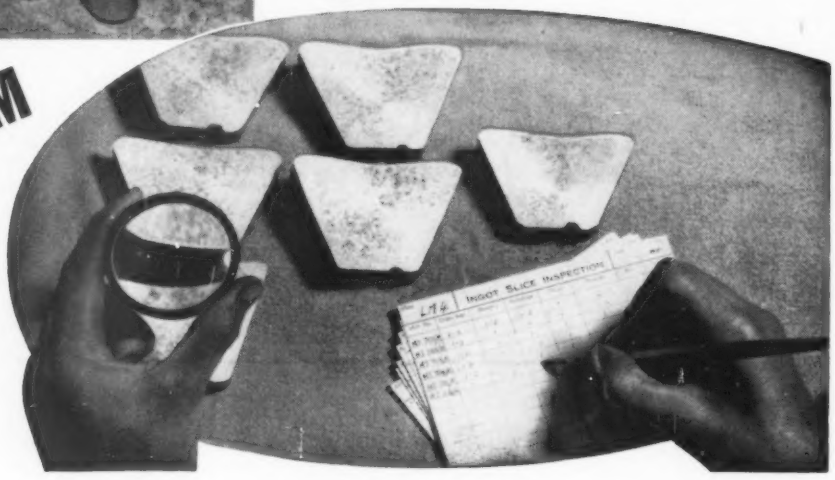

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